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A Journal of Scottish Natural History

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ARDENTALLEN:
THE NATURAL AND LAND USE HISTORY OF AN ARGYLL PENINSULA

By DONALD N. McVEAN
Craignish Conservation Trust

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Foreword

The Craignish Conservation Trust was established as a Charitable Trust by Ms. Caroline Younger of Craignish in 1979. Its aims were threefold: to consider the use of marginal land in general, with a view to proposing alternative land-use systems which are both economically feasible and biologically sustainable; to study plants and animals which may have a role in these systems; and to disseminate an understanding of the role of habitat conservation in multiple hill land use in Scotland.

With our limited resources we could not ourselves set up all the projects we should have liked. Instead we saw our role as, in part, acting as a 'pump primer'. That is, we tried to help projects get started, supported those in progress, and financed feasibility studies for the larger and worthy undertakings. Thus the Trust, in its sixteen years' existence, has spread its funds in relevant research in such a way that the investment has had an effect much greater than is reflected by its amount.

The Trust has also leased several small offshore islands in Argyll in order to make observations on grazing animals and vegetation there, and through its Factor, Dr. Donald McVean, has studied the peninsula of Ardentallen near Oban. While research in the area has now ended, due to the death of the previous owner of Lower Ardentallen and its purchase by a new owner who does not share our ideals, the Trustees believe that the study to date is well-worth publishing, not only for its intrinsic interest, but also because of its relevance to many similar areas in west Argyll. It gives a fascinating insight into the wealth of detail waiting to be found by the careful observer and into the kind of environmental enhancement which can be brought about by sensitive management based on ecological understanding.

James D. Lockie
M.E.D. Poore
(Trustees)

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INTRODUCTION

Ardentallen (or "the height of the sea inlet" in the original Gaelic) lies a few miles south of Oban in the old territory of Lorn at the end of the public road to Lerags and Ardentallen House. An oakwood is known to have existed here on the north side of Loch Feochan at least as early as 1750, and it must have consisted at least partly of mature trees when mapped at that time by General Roy (Figure 1). This present account resulted from my efforts to regenerate and restock a section of the wood under the existing regime of hill sheep grazing. The original intention was to tell the story in photographic form, with extended captions and with a minimum of background information. However, as the years went past, this background material to the woodland rehabilitation began to assume ever greater importance, with minor discoveries in geology, archaeology, the local flora and woodland ecology. The coffee-table book layout was therefore abandoned in favour of a standard format which would do more justice to all aspects of the multi-disciplinary approach. Since the controlling factors at work in vegetation dynamics involve the local rocks, soils, climate and animal life as well as the history of human land use, all these had to be examined, at least superficially.

It was soon apparent that many vital factors were inadequately known. Historical records were completely absent prior to the late 17th century, and information on land use, whether related to the woodland or not, was particularly sparse compared, for example, to that from the nearby island of Kerrera. The only solution, therefore, was to attempt an interpretation of the land use features still discernible, to disentangle these from the geomorphological and archaeological evidence, and to supplement this with the verbal accounts of those individuals who had been familiar with the ground at first or second hand for the greater part of the present century.

I came to live in Ardentallen in late 1970, but was then working mainly overseas in the fields of land use and environmental ecology. Until the late 1980s there was little time to devote to any serious local study, although it was evident from the start that this might be rewarding. It was always a chastening experience to return home from spreading the word on responsible land use in other countries to a prime example of "how not to do it" on my own doorstep. In particular, the sight of sheep browsing on successive crops of tree seedlings, and thus depriving an essentially moribund woodland of any hope of future existence, was hard to tolerate. The system was a form of ranching and the economy wholly extractive. It was also plain that much more than the natural forest capital was being squandered without thought; many distinctive and interesting local plants, not all woodland species, were fast disappearing, while bracken continued to extend across the best of the grassland at a disturbing rate. Changes in the ownership of

the land took place about this time. I obtained a sympathetic hearing, and began the present study in earnest in the autumn of 1986, although without any formal management agreement or control over the grazing tenancy.

The end result of the study has been this rather idiosyncratic account of natural and land use history, with some tentative suggestions for future woodland management. It is a 'popular' account only in the sense that it is certainly not a scientific treatise. It is brief and interdisciplinary, and the experimental trials which form the background to the woodland account have lacked scientific rigour and statistical validity. There is no glossary and often no explanation of the terminology used, on the assumption that the reader possesses the necessary background. If this is not the case, then recourse must be had elsewhere, since much space has been saved here by the omission of background material which can be found in hundreds of sources. There is a short list of direct references.

There are three main themes: firstly, the rehabilitation of the wood and a greater understanding of oakwood ecology; secondly, the archaeology and land use history of the Ardentallen peninsula as it bears upon the first theme; and thirdly, an exploration of some byways of the natural history, leading to an affirmation of 'National Reserve' quality of the whole. Much of the plant and animal life of the area remains uninvestigated, and unfortunately there now seems little hope that this will be remedied in the near future by others more qualified in the various groups.

If Ardentallen is exceptional in any way, it is in the vegetation and plant list of the small area of 'ancient' woodland now fenced against sheep. A similar study could have been carried out in many parts of western Argyll, and surprises of a different sort probably been obtained. In the course of this particular study, many digressions have been made, some of these being the continuation of previous work in other places and only some of which have been described here. Descriptions tend to be largely anecdotal, and it remains for others, should they so desire, to test more rigorously any new hypotheses here advanced. Tests of this kind can be carried out only where experimental work is not liable to damage or destruction from day to day or from one year to the next, as has been the case at Ardentallen.

The study period of 1986 to 1994 ultimately proved to be but a passing phase. Another change of ownership took place in July 1994, and it no longer became possible to continue either the work of woodland restoration or attempts to delay the loss of species diversity. And so the wheel has come full circle and sheep once more dominate the land use, leaving only a thousand or so young trees which would not otherwise have survived. This has certainly not secured the future of the woodland, which is still in jeopardy and must remain so unless a vigorous

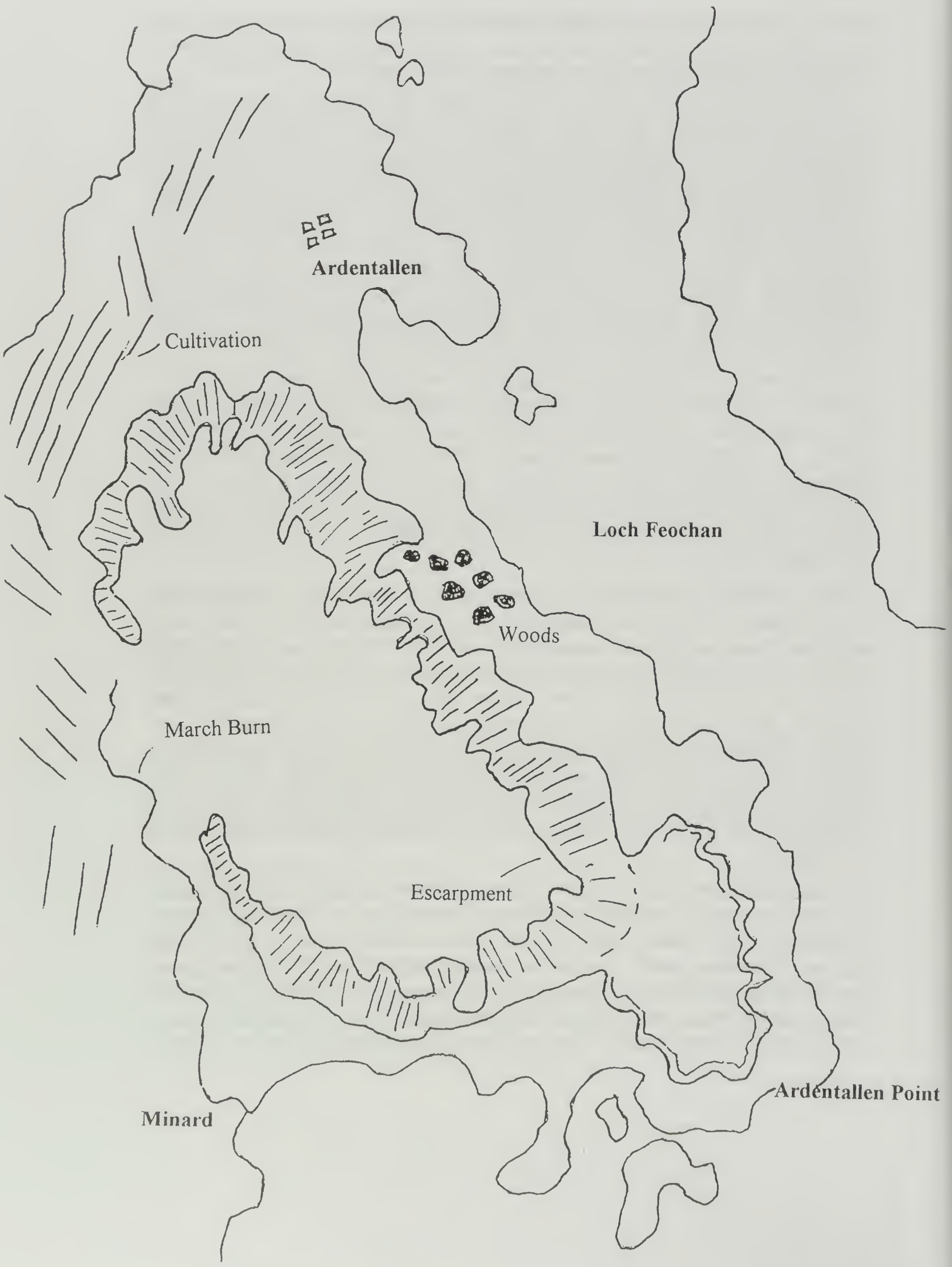
Ardentallen
Cultivation
Loch Feochan
Woods
March Burn
Escarpment
Minard
Ardentallen Point

Figure 1

The Ardentallen Peninsula
on General Roy's military map of 1750.

Enlarged to c. six inches: one mile.

programme of regeneration and/or planting, at least equalling the effort to date, can be undertaken. Indeed, in retrospect, the entire endeavour now appears to be a shade quixotic.

How hopes for a system of management, more in keeping with present trend of integrating farm stock and native woodland on hill ground, came to be blighted is told in greater detail in the final section of this work. What was originally hoped to have been a success story has turned out instead to be a cautionary tale of how a conflict of personality and idealogy can bring the best of intentions and considerable effort to a premature and unfortunate end. Nevertheless, it is right that the story should be told, for it is normally the success stories, and not the failures or even the partial failures, which are documented and the path of biological conservation thus made to appear too smooth. In particular, the conservationist should beware of expending too much of his energy and expertise on land where he has no legal tenure; it is so easy to be drawn into a long-term commitment, such as the present one, by goodwill and verbal agreement which can, in the nature of things, disappear virtually overnight. Title to the land in question is everything, as it has been here since the days of Donald Campbell of Lochnell.

The present account will also expose the existence of a pathetic fallacy in the conservation field, which mirrors that in literature, where nature is conceived as mourning and rejoicing along with humanity. In this case, it is too often maintained that all one has to do is to work with, rather than against, nature and everything will come out right; nature seems in some mysterious way to understand your good intentions and will smile upon you. On the contrary, nature often seems to fight back more savagely against the well-intentioned than against the accidental or deliberate wreckers. If you would rescue a Wild Cat from a gin trap, take care to wear stout gloves and a fencing mask!

LOCAL CLIMATE

The local climate of the Ardentallen peninsula is that of coastal north Argyll, cool and oceanic but hardly 'hyperoceanic', as it has been termed recently by lichenologists from the south. The fairly frequent periods of intense spring drought and occasional hard winter frosts (together with numerous early and late ground frosts) give the lie to such hyperbole. Nevertheless, the general lack of continental winter cold and summer warmth justify the use of the term 'temperate', even if this is sometimes more than half ironic. Coastal south Argyll and the Clyde area show by the presence of several plants, which drop out or flower less readily north of the

Tarbert isthmus, that summers are just that little bit warmer and winters a shade milder to the south, while the opposite effect is seen north of Ardnamurchan.

The dog-leg in Loch Feochan, together with the indentation of the outer loch at the mouth of Minard Glen, creates a virtual peninsula culminating at Ardentallen Point. The abrupt change in direction of the loch, from almost east-west to north-south, also results in the ponding of cold air drainage in winter, so that the local climate of the inner loch is much less maritime than would be supposed. Garden makers on the west Highland coast know this phenomenon well; it is better to build up shelter on an exposed site by means of woodland and scrub, rather than to have topographic shelter provided at the expense of cold air ponding behind a barrier to the prevailing wind. Frost-tender plants, which survive easily on the coast of outer Loch Feochan, are likely to be frosted in most winters on the slopes of the inner loch. The proximity of the sea at the inner location is no protection, and the loch behaves like an inland body of fresh water with the same extent of cold air catchment. In winter and early spring, cold air ponds to a depth of 70 - 80 m across the loch, and frost smoke can often be seen rising from the surface of the water. On such a still night, the thin layer of fresh water spreading from the Feochan river freezes to form a sheet of ice as far as Eilean nan Ruisg or further, and this breaks off in small floes which drift down the loch with the ebb tide.

Over the last two decades, winter minimum temperatures have hardly fallen below -5.0°C and summer maxima have rarely attained 24°C. The average annual rainfall works out at around 2165 mm, but rainfall has been steadily increasing since the early 1970s and reached 2550 mm in 1990.

Generally speaking, climatic factors are not critical in the present study, although numerous references are made to them in the appropriate places.

GEOLOGY AND GEOMORPHOLOGY

General

The land between Loch Feochan and Oban, including the Ardentallen peninsula, is essentially part of the Lorn Plateau to the east, a large expanse of Devonian or Old Red Sandstone (O.R.S.) volcanic rocks, for the most part andesite lavas. The lowermost lavas rest either upon Dalradian black (graphite) schists and slates, or upon a thin layer of sedimentary rocks of O.R.S. time. The andesites of Ardentallen are separated from the overlying Oban lavas by a thin parting of sedimentaries, extending through Minard Glen to Lerags and folding back on itself above Minard Farm.

The Shore Section

A walk along the shoreline from Ardentallen House to Ardentallen Point, and then northwards to Minard Cottage, reveals most of the variety which exists within the Dalradian and O.R.S. sedimentary rocks. Ardentallen House and Farm stand on an extensive area of slates which have been quarried in the past and extend as two sharp crested reefs into the bay of Sailean Ruadh. Around the bay, the slates contain one concentrated bed and a wider scatter of peculiar flattened inclusions, which are sometimes rounded discs, sometimes spindle-shaped, or resemble whole living mussels. These are not the calcareous concretions known to the former slate workers of Easdale, but appear to be water-rolled pebbles of a fine-grained and heavy igneous rock rich in minute crystals of iron pyrites. The slates themselves contain the same mineral in 1.0 - 2.0 mm cubes, which have mostly weathered out to leave little cavities. No reference to these pebbles in the slate has been encountered in the literature.

At two points along the shore to the south-west, and at one locality some distance up the hillside, there are beds of the Dalradian black limestone - which has been recrystallised and contains numerous silica veins - but these are too localised to have much influence on vegetation composition, although they are surrounded by a brighter green turf attractive to the grazing sheep. The upper (northward) beds of slate pass into a black, calcareous mica schist and a wider band of brown, rippled phyllite immediately underlying the andesite. These beds resemble rocks in the Craignish sequence to the south, to which they correspond in the whole Dalradian suite. At the two water-filled quarry holes, the slates give way to the Ardentallen 'greenstone' which was formerly quarried here. This is not a geological greenstone, but a current-bedded greyish green freestone containing minute micaceous flakes perhaps from the schists mentioned above. It appears to be slightly calcareous. On the hillside, just west of the quarry, lies a thick bed of red sandstone capped by andesite and forming a prominent cliff within the woodland. Its relationship to the underlying grey sandstone cannot be seen, but the lowermost few centimetres are soft and shaly. This is not a working quarry face but appears to be the backing cliff of the main post-glacial shoreline. The grey sandstone has also been quarried at a number of points on the inland side of the present road, and at sea level near Ardentallen Point.

The main slate quarry workings can still be seen, as tidal holes and a levelled spoil bank where the shoreline bends to the south around the garden ground of 'Caladh' (Brown's Cottage on older maps). There is also a well-built quay flanking deep water in the main tidal channel. Close to Ardentallen Point and just above H.W.M.O.S.T. lies the quarry face of grey sandstone mentioned above and

illustrated in R.C.A.H.M.S. Argyll Volume 2 (Steer, 1975). The sandstone is directly capped by andesite here, but only a few metres to the east a thin bed of red sandy shale lies immediately below the lava. The sandstone bed can be traced up the steep south-facing slope in the direction of Lower Ardentallen, but the workings have not followed it. There is obviously considerable faulting along this coast and the relationship of the different beds is difficult to disentangle.

From Ardentallen Point to the north, the andesite extends below sea level all the way to Minard Cottage, except at one locality right on high tide mark where a bed of white limestone can be seen. Just short of the Ardentallen march there is also a thin bed of brown impure sandstone in the same apparent horizon, which strongly resembles the thick bed of brown sandstone near An Dunan at Minard Point and which is regarded as marking the separation of the upper and lower lava sequences. One small bed of indurated brown sandstone or quartzite has been found isolated in the andesites on the high ground of Ardentallen, and one small slab of white recrystallized limestone, about the size of a coffee-table top, has been seen in the woodland some 30 m above the shore limestone. According to the geological map sheet memoir, these isolated occurrences are evaporites and *in situ*, but in appearance they seem more like transported fragments. A similar slab occurs in the andesites to the north of Minard Point 100 m above sea level. The thin brown sandstone bed on the Ardentallen shore is not mentioned in the geological memoir (noted above), although the sea level limestone bed is mapped and commented upon.

The Landward Boundary

If we proceed around the Ardentallen march in the other direction, instead of sandstone a 6.0 m bed of conglomerate separates the slates from the andesites. This corresponds to the impressive conglomerate cliffs at Oban, Gallanach and Dunolly. There used to be a good exposure of this rock by the roadside at Lerags House, but it has now been obscured by road improvements. To the south-west of this exposure, a thin bed of conglomerate can still be seen which is over- and under-lain by the lavas. Following up the burn which divides Ardentallen from Lerags Farm, a flaggy red sandstone can be seen in its bed close to where the glen suddenly narrows. On the hillside above this to the south, a thin bed of conglomerate, again with andesite above and below, can be seen in two outcrops some distance apart. Beyond that point, nothing of the sedimentary sequence can be made out until Minard Farm is reached, although the lime content of the water in the westward-flowing burn indicates that lime-rich rock of some kind exists in the vicinity. It should be remarked that none of the sedimentary rocks on Ardentallen has been found to be fossiliferous.

Volcanics

In this area the lower O.R.S. vulcanism appears to have opened explosively with a deposit of red tuff which, in its thickest bed, seems to have been laid down in water. It closely resembles a red sandstone in the field. At low magnification this rock can be seen to consist of closely-packed crumbs or lapilli, some red, some brown and some purple, cemented by light grey calcium carbonate to give a distinctive marbled effect. Derived soils are potentially very fertile and carry a number of calcicole plants. The hardness of the tuff varies; where it is faulted against the red sandstone cliff described above it is soft and flaky, but to the north it becomes as hard as the sandstone and projects as little crags from the 45° woodland slope. Here it is at least 2.0 m and perhaps as much as 6.0 m thick, and can be seen to underly a purple agglomerate or volcanic slag, although the base cannot be made out. The bed thins northwards to end on the north side of the 'sanatorium' hollow (see page 25) where it appears to pass into the cementing ash of the agglomerates. The bed also thins to the south, but its relationship to other rocks cannot be seen there. The total length is about 1.0 km. A similar rock occurs about 0.5 km to the west in association with one of the possible volcanic vents at 50 m above sea level. Only a small craggy outcrop can be seen, but the soil is coloured a distinctive reddish-brown on the surrounding hillside.

There are a least four sub-circular features breaking the regular succession of the lava flows on Ardentallen which could conceivably mark the explosion vents of this period. The sanatorium hollow is one, and it has a central spring which runs only in very wet weather. The remainder lie on the high ground and are seen as badly drained depressions, one with a permanent watercress spring, indicating highly calcareous rocks, and with marked surrounding vegetation zonation. The other two hold acid soligenous/topogenous bogs. A less definite vent below the watercress spring carries what is left of the acid bog which once supplied the farm of Lower Ardentallen with peat. To the south-west of this depression there is an irregular outcrop of intrusive dolerite, measuring some 150 m by 80 m and forming distinctive hummocky ground with good quality bent-fescue grassland. The intrusion, which is probably a sill and is cut by a Tertiary dolerite dyke at its south-west end, has neither been mapped nor described by the Geological Survey. The high ground to the north-east of this bog contains a deep-weathered basic intrusion of some kind, whose deep brown soil has been exploited by badgers for sett digging, perhaps over many centuries. Fresh rock cannot be obtained nor can the extent of the outcrop be determined, although it can be traced for some distance downhill into the woodland. In general, the O.R.S. vents of the district consist of harder porphyrites or dolerites which stand proud of the andesite lavas.

The expulsion of ash from the vents was followed by cinders and bombs, which have solidified to form tough and heavy agglomerates; red, brown and purple in colour like the lapilli in the tuff, on a grander scale. At a later stage this has been percolated by water rich in lime, so that pockets and seams of calcite are found in many places. These are quite distinct from the small slabs of limestone described above, although all may have fundamentally the same origin. By way of contrast, the more quietly extruded lava flows which followed the earlier violence are less calcareous, and their steam cavities are generally filled with milky blue chalcedony or rough agate. The many flows of vesicular lava are intermediate in texture, toughness and acidity. Amygdaloidal types with quartz or calcite fillings rarely occur until the overlying Oban lavas are reached. The solid andesite is grey or brown in colour, with frequent blotches and both straight and folded lines of red rock so rich in iron oxide that it can be used as marking chalk on a rough surface. It shatters readily and allows water penetration more easily than the agglomerate, so that springs and seepage areas often occur at the junction of the two types.

Late-Glacial and Flandrian Features

During most of the last or Devensian glaciation the Ardentallen area, in common with the remainder of the western Highlands, was deep under an ice sheet moving west to south-west. The most striking evidence of the later phases lies in the enormous boulders of Glen Etive granite which lie scattered across the landscape, from below high-tide level to the tops of the low hills. Boulders many tons in weight are poised above the cliffs of Cnoc na Faire near Minard Point at 100 m above the sea. These erratics are the surface evidence of a thin veneer of glacial till, containing smaller boulders and pebbles of the granite as well as a wide variety of other rocks from many miles away to the north-east. In the course of time some of these have become detached from their matrix of sand, clay and gravel to lie scattered on the surface or mingle with more numerous angular fragments of the local rocks in talus and scree slopes. The till may be thin or absent over the higher ground, but can form deep pockets in clefts and hollows. Smoothing and striation of the bedrock by the ice sheet is obvious in few places, because of later frost-shattering to which the local andesite is prone. During this final period of cold periglacial climate, which is known in Scotland as the Loch Lomond stadial (or ice re-advance), the Ardentallen area lay close to glacier terminations on all sides save the south-west (see below) (Figure 2).

At the end of the main Devensian glaciation, an ice cap, centred on the high plateau of Rannoch Moor, engulfed the coast and islands of Argyll with the possible exception of the tip of the Kintyre peninsula. Rapid wasting of the ice took place around 17,000 to 18,000 years ago as climatic warming advanced and,

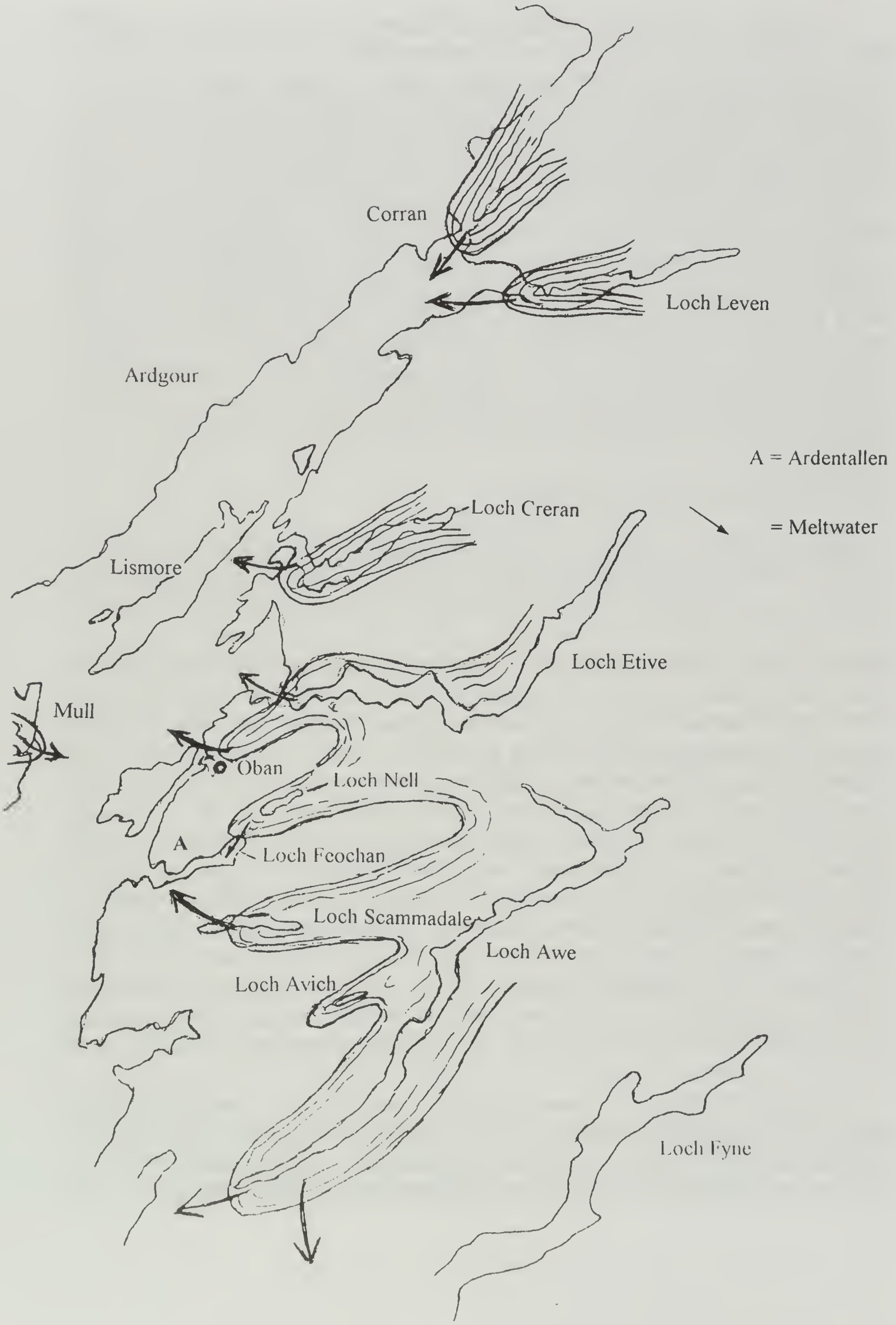

Figure 2

Terminal glaciers of the Loch Lomond Stadial.

although world sea levels at this time were 70-100 m below present sea level, the sea of coastal Argyll was about 45 m above present level due to crustal down-warping caused by the weight of the remaining ice. As the Ardentallen peninsula emerged from the ice it was probably a true island lying off the shore of a still larger island, now the Oban hinterland, with the sea extending from Loch Etive and Loch Feochan by way of the present Black Lochs and Loch Nell, and also running through the gap from Lerags to Minard. The latter gap was probably formed during the main glaciation, by the gouging of the ice along the softer band of sedimentary rocks separating the Oban and Ardentallen lavas.

In the absence of any large stream on Ardentallen 'island' at this time, there is no depositional evidence of the high sea-level, such as there is nearby at Balinoe, at Raera above Kilninver and, further off, at Kintraw, Loch Craignish, where fluvio-glacial deltas and terraces were formed. However, small pockets of glacial till, which may show signs of having been resorted as beach gravels, can be found at the appropriate level to the north of Lower Ardentallen. Another legacy of this deep and rapidly warming sea is the shell bed extending across the embayment between Lerags House and Ardentallen House just below the present saltmarsh turf (see Appendix 4). The rapid temperature rise of those times is attested by the occurrence of eroded shells of a cold-water mollusc *Cyprina (Arctica) islandica,* mingled with beautifully fresh shells of oyster, queen scallop, pelican foot shell and many others still apparently *in situ* in the deep, tenacious marine clay. These species all occur around the British coast today, but in deep water in currents of different temperature.

The clay is neither a straightforward boulder clay nor deep-water marine clay, but appears to be related to a class of sediment found worldwide from the Netherlands to Australia, and supposedly formed during the late-glacial marine transgression. The coastal inundation resulting from rising sea levels mobilised land sediments which were deposited in coastal embayments, where they often became highly organic and pyritic due to concentration and reduction of sea-water sulphates. They were often colonised by mangroves on tropical and subtropical coasts, and have often been reclaimed for crop growing by deep drainage, which causes oxidation of the sulphides and formation of highly acidic sulphate soils. In western Argyll, solifluction of the glacial clays around the margins of the Loch Lomond ice lobes may have helped this deposition of sediments in the sea lochs, where they now form deep deposits. The depth of the clays is not known but could easily exceed the 10 m recorded, for example, along the Tweed River in New South Wales. Recently a J.C.B. excavator was lost without trace in the same type of coastal mud between South Shian and Ledaig in Benderloch.

The climate then remained relatively mild for several thousand years, and there may eventually have been little or no ice remaining anywhere in the Scottish Highlands. The vegetation which developed over the low ground seems to have been similar to that of coastal Iceland or southern Greenland today, with birch and other scrub types but no woodland or forest. Sea level fell due to rebound of west Highland crustal rocks overtaking the general rise in world sea level. At one stage the sea level actually fell slightly below its present position, and around this time inner Loch Feochan could have been fresh-water, overflowing a fluvio-glacial dam from Ardentallen Point to Kilninver along the course of the present navigable channel. The curving north-east front of this deposit is still well seen at low water springs (marked as *Oitir nam Ingilt* on Roy's map).

Loch Lomond Stadial

Ice, but not an ice cap, returned between 11,000 and 12,000 years ago during a resurgence of cold which has been mentioned above - the Loch Lomond stadial. In mid-western Argyll, glacier tongues terminated at Connel and Pennifuir, almost in the outskirts of present-day Oban, at Loch Nell, Loch Scammadale and the south end of Loch Awe. A small glacier managed to reach the sea at Loch Spelve on Mull (Figure 2). For a short time, the climate in this district was periglacial, but not as arctic in its severity as in the eastern Highlands. Nevertheless, exposed andesite readily shattered in the alternating frost and thaw, to form the basis of present sedentary soils where there was no veneer of till. Scree and talus which still mantle many slopes, even on the low ground, were formed then, and some downhill movement of the finer soil particles appears to have occurred under the influence of the same alternating frost and thaw (solifluction) mentioned above. Coastal shelf ice probably formed in hard winters, and this could have been responsible for plucking chalk and flints from the exposures on Mull, to deposit them eventually on mainland beaches as a result of a clockwise gyre in the sea currents in the Firth of Lorn. Alternatively, the chalk and flints of Lorn beaches could be derived from Mesozoic deposits known to be submerged in the Firth of Lorn between Duart Point and Carsaig on Mull.

The sea rose, fell and rose again to approximately the same level as before, leaving raised beaches in places and forming what is now known as the main post-glacial shoreline at about 13 m above present sea level. By a confusing chance, this coincides with an earlier marine cut platform whose landward cliff-line is such a prominent feature of the Argyll coast. The precise time of formation of this platform is not known, but it could not have been later than the last of the great interglacials before our own, more than 118,000 years ago. It may have been earlier still, but none of these interglacials has left traces other than this in the region. The platform and cliff-line were destroyed by subsequent ice erosion in

some places, but have mostly survived under deep deposits now removed. The Ardentallen cliffs are not impressive, as they are nearer Oban or on Mull, but they do have a few little caves and rock shelters marking former high sea-level at their base. Many of the caves are now blocked or obliterated by rock-falls.

The smooth sweep of green, grassy ground between Lower Ardentallen and Ardentallen Point belongs geomorphologically to the Kilninver area across Loch Feochan, because it is part of the same fluvio-glacial debris spread from Glen Euchar and Glen Scammadale. Between rock outcrops the level tops of old terraces, corresponding to the lower series across the loch, can be seen, and this material has been worked into a storm beach at 13 m above sea-level at one point in the exposed north-west corner of the grassland facing out to the Firth of Lorn. The beach cobbles now lie at plough depth, and in the course of cultivation some of the surface stones have been gathered off into cairns. Just below this, on the shore of the outer loch, there is a less distinct beach at only 1.0 - 2.0 m above high-tide level. Close by, a less extensive area of former cultivation still shows the marks of ridge and furrow ploughing. Along this stretch of coast there is a band of clay with glacial cobbles and mostly fragmented marine shells just above H.W.M.O.S.T. (Appendix 4, Site D). Wherever these raised clays occur along the coast there are now shore marshes with rushes and yellow flag irises, due to impeded drainage.

Another interesting deposit of shelly clay in a more sheltered situation has been found at the rear of the landward of the two water-filled sandstone workings in the inner loch. Here an old beach deposit of reworked clay, with gravel, cobbles and shells, lies beneath a metre or more of solifluction head or avalanche debris and on top of over 2.0 m undisturbed marine clay (Appendix 4, Site A). The top 10 cm or so of the clay is highly calcareous due to the presence of finely-ground barnacle shells - in fact, a true marl. Some of the larger cobbles still carry attached barnacles of the two common species, and the whole shell assemblage here is completely different from that below the saltmarsh mentioned above (Appendix 4, Site B). The low position of this deposit on the shoreline indicates that, unless it has survived subsequent inundation by the sea, followed by further uplift, the overlying 'head' is not soliflucted material but slippage of more recent date.

A smaller storm beach, again at 13 m above sea level, at one time seems to have blocked the course of the Minard burn just above the cottage. This could have produced a temporary but quite extensive loch in the glen. There is indeed some indication of an incised loch margin, at the same height as the beach, on the more exposed Ardentallen side of the glen. A small lochan may have persisted at the north end until agricultural drainage, with straightening of the burn, took place in

the 18th century or later (see page 38). The surviving marshland is underlain by 3.0 m of sediments.

Further reference to Flandrian deposits (peats, etc.) is more conveniently dealt with under Archaeology (see later section).

SOIL SUMMARY

The principal soil types are determined mainly by the parent rocks described above and by the drainage pattern. The slates give rise to black, tenacious clays which are hard to drain and are mainly colonised by bog rushes at the present day, although they have been cultivated in the past. Lavas of all types have brown, well-drained soils, again with a high clay content and becoming very slippery after rain. The volcanic tuffs give a distinctive reddish-purple soil, which is potentially the most fertile of all but is too restricted in its distribution to be of any agricultural significance. Other rock types, such as the black limestone, may affect the composition of drainage water and hence the local vegetation and palatability of the herbage, but are too restricted to influence soil formation.

The principal soil types seen at Ardentallen are as follows:

Acid podzolic brown earths of woodland, grassland and bracken ground. On lavas and glacial tills.

Neutral brown woodland soils on steep wooded slopes. Skeletal and almost all derived from the tuff and the more calcareous agglomerate.

Hill peats. Resting directly on bedrock or on badly-drained glacial till.

Hydromorphic soils and peats. On old marine clays of the raised beach. Also on the black schists and some badly-drained hill ground. Some show grey mottling.

Traces of an iron-rich B horizon can be seen in some of the acid brown earth and hydromorphic profiles.

ARCHAEOLOGY

In comparison with many of the surrounding areas, such as Kilmartin Glen to the south and Loch Nell to the north-east, the Ardentallen peninsula is not rich in evidence of early human occupation. Nevertheless, about twenty features of

potential interest have been recorded in the course of the present study, and one or two of these have been cleared of bracken and moss or excavated. There is a definite association between the traces of Neolithic and Bronze Age man and the fertile, free-draining soils developed on fluvio-glacial debris of the last glacier fronts. Abundant loose cobble stones were also available here for cairn building.

Mesolithic

One Mesolithic shell-midden has been discovered, in which a blackened soil, with abundant limpet and winkle shells, occurs beneath a rock overhang at the top of the main post-glacial shoreline. The deposit meets the roof at the back of the cave and the soil surface is caked with generations of sheep dung. There has been no systematic excavation here, but there have been several episodes of surface disturbance since the overhang has been frequently used as shelter by shore walkers and campers. The depth of the deposit remains unknown. Many interesting discoveries have been made at similar sites and in genuine caves around Oban, which has long been something of a *locus classicus* for traces of the hunter-gatherers of 8,000 to 6,000 years ago.

Glen Shellach

Contemporary excavations ahead of development in Glen Shellach, some 5.0 km to the north of Ardentallen, have revealed a scatter of flint microliths below formerly cultivated grass turf, again on the main post-glacial shoreline. This is the first evidence of Mesolithic occupation associated with nearby shell-middens to be found anywhere, and there are also traces of hut foundations which may belong to the same period. Post holes, fireplaces and stone-lined drains at the same site may, however, turn out to be Neolithic, and be contemporary with evidence of cultivation and cereal growing revealed by peat-coring further up the glen by a team from Newcastle University (Macklin, Rhodes and Rumsby, 1991).

Bronze Age

Only one of the many cairns and stone settings at Ardentallen has so far been excavated, and this has been pronounced as a Bronze Age cremation burial, of kerb cairn type in which there is no central stone cist, but in which the ashes of the cremation have been heaped in a central stone-free patch and capped with slabs of the local grey sandstone, supported partly by the ashes themselves and partly by the surrounding boulder fill (Figure 3). There was no surface cairn of loose stones here, only a patch of earth-fast boulders of which three or four broke turf among the bracken. Grave goods or other artefacts were absent, and few pieces of

Figure 3

Bronze Age kerb cairn excavated in the spring of 1992.
The walking stick is 1.0 m long, and the original soil level can be seen on several kerb stones.

collectable, unburned bone remained. Arrangements were made to have a radio-carbon dating of charcoal from this cairn carried out, but results have not yet been received. Another kerb cairn has been recorded at Lerags, some 2.0 km to the north-east. It is figured in R.C.A.H.M.S. Argyll Volume 2 (Steer, 1975).

Neolithic, Iron Age and Later

Other cairns and stone settings may belong to Bronze Age, or may represent Neolithic, Iron Age, early Christian or even medieval activity on the peninsula. The nearest Iron Age forts and duns lie around Ardentallen at An Dunan, Minard Point, Dun Bhlaran in Minard Glen, and at Dunan Corr on Lerags. Others are not far off, at Barnacarry and Ardoran. The people of these times must have lived and cultivated the land somewhere close at hand, but evidence is lacking and we can only suppose that they grew their crops where subsequent generations did, on the hill slopes above the woodland, on the flanks of Minard Glen, and on the fluvio-glacial gravels at Lower Ardentallen. There are a number of round-ended house foundations associated with traces of former cultivation close to Dun Bhlaran, but only one foundation of this type has been found at Ardentallen - at a similar altitude and close to ridge and furrow marks.

The largest single stone assemblage of undoubted prehistoric date at Ardentallen could be interpreted either as an unfinished or as a stone-robbed cairn 15 m in diameter, and flanking patches of earth-fast boulders and stone settings on an elongated mound with some of the superficial appearance of a chambered cairn. The largest collection of miscellaneous stone structures lies in or close to the south-facing woodland bowl of the 'sanatorium'; [this is a local joke dating from 1881-1882 with the abortive construction of the Hydropathic Sanatorium in Oban]. There are stone banks, hut platforms, small rounded patches of earth-fast boulders, and the base of a rectangular stone hut of two compartments and with an end doorway. This complex is more than 30 m diameter and resembles the remains of a small cashel or rath, or perhaps an early Christian burial ground. Just below the hollow there are other stone alignments, cairns and possible inhumation burial cairns, one of which is now enclosed in garden ground. Much charcoal has been found under one circular stone setting at the rear of the sanatorium.

Regional Vegetation and Human Occupation

Here we must digress for a moment, before proceeding to historic times, to look more closely at the early human occupation of the whole district and at the vegetation cover of those days. The first trace of human occupation of the Oban area has been dated to 7,900 years before present (B.P.) or just as the Holocene

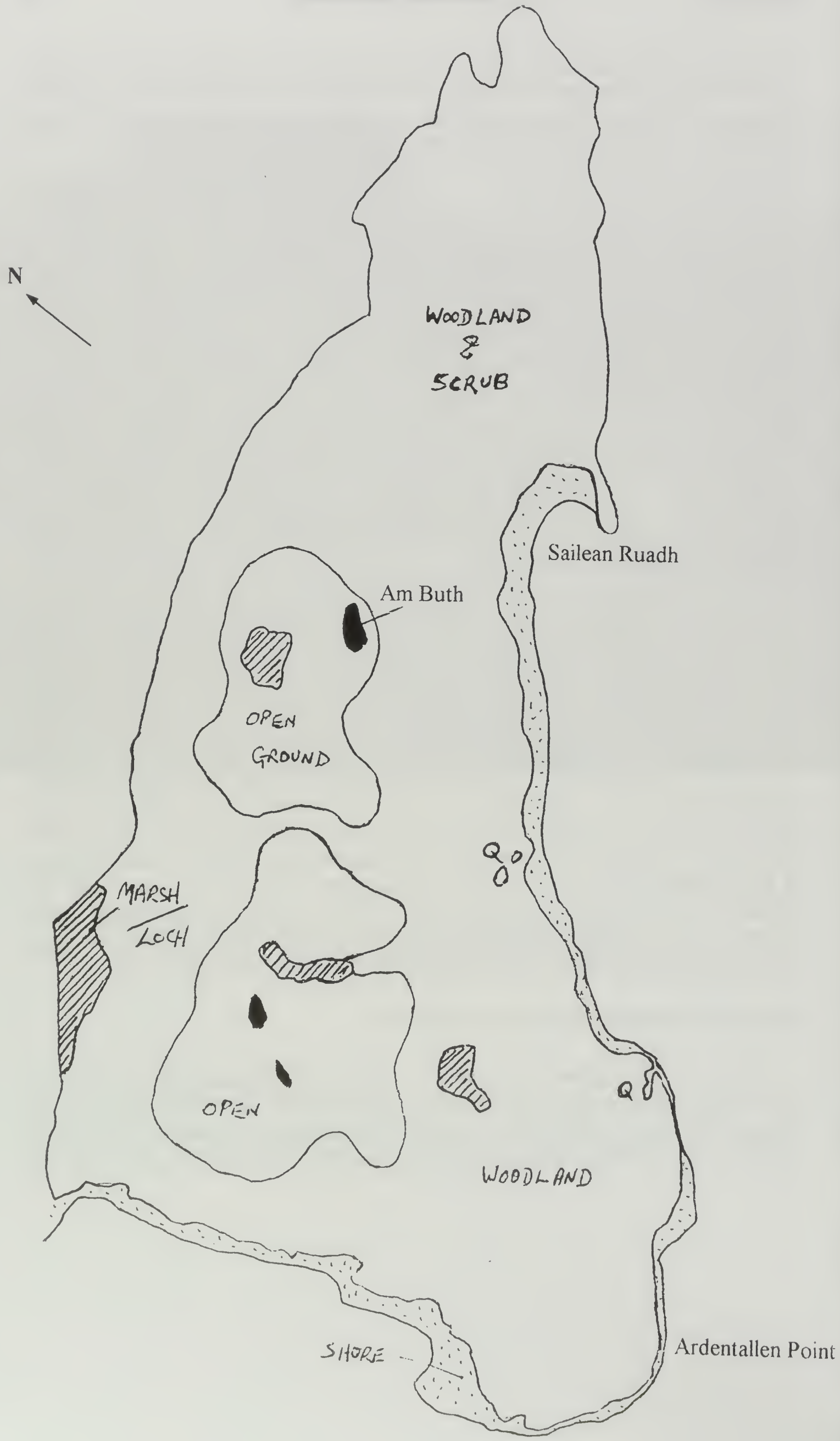
N
WOODLAND & SCRUB
Sailean Ruadh
Am Buth
OPEN GROUND
MARSH / LOCH
OPEN
WOODLAND
SHORE
Ardentallen Point

Figure 4

Possible maximum woodland cover of Ardentallen.
(c. 7,000 - 5,000 years B.P.)

Scale c. six inches: one mile

Land >90 m high

Bog >3 m deep

Q Quarries

period of maximum summer warmth was declining in the western Highlands (dated 9,000 to 8,000 years B.P.) Greenland ice cores show that, some 8,200 years ago, there was a sudden climatic cooling by 4.0°C, which lasted about 200 years and then abruptly reversed. The Greenland cores also show that over the last 10,000 years the earth's climate has been more stable than at any other time in the past 100,000 years, but there is some evidence that climatic variability is increasing again.

Contrary to what has previously been believed about the slowness of climatic change, the cores also demonstrate that any climatic 'flips' have taken place over very short periods of one or two years. In other words, both climatic amelioration and coastwise movement of Mesolithic hunter-gatherers followed hard on the heels of the retreating glaciers.

There would have been extensive thickets of birch and hazel with some elm and oak woodland groves by this time, but man seems to have arrived before the ash and before alder had extended sufficiently to make a significant contribution to the pollen rain recorded in peat bog deposits. The main edge of the northern pine forest was not far off, near the mouth of Loch Etive, but in fact the pine never arrived, either by this route or by way of the northern advance through Galloway. Much the same species would have been present as today, but with more heather, juniper and blaeberry and a greater variety of willows. The 'climax' oak forest of Argyll, which developed somewhat later, seems not to have had the same intermixture of other tree species which characterise the main oak forests of the south, and it is interesting to note that it must have developed in the presence of domestic grazing animals, unlike the rest of European mixed oak forest.

Figure 4 shows the possible maximum extent of woodland on the Ardentallen peninsula 7,000 to 5,000 years ago. Alder-willow carr or woodland probably developed on the badly-drained clays northwards from Sailean Ruadh, but the remaining woodland must have been similar to the present oak and ash dominated woods of today, once the ash had arrived. There was probably little but stunted scrub on the exposed western slopes above 50 m or so at any time.

The Mesolithic people had little effect on the land in which they found a living, although they may have burned much forest and scrub, as they have been shown to have done elsewhere, but the effect was transitory, unlike later deforestation, which was rendered permanent by domestic stock grazing combined with climatic deterioration in the form of higher rainfall and lower temperatures. There does not seem to have been a single 'Atlantic' period of deterioration, which was formerly postulated for the whole of western Europe on the basis of central European

investigations. Instead, we seem to have experienced a number of oceanic episodes in the west Highlands, one of which began shortly after 7,000 B.P., and may have been responsible for the expansion of alder around this time, in combination with the coastal drainage problems consequent upon rising sea levels. Others followed at 6,200 - 5,800 B.P., 4,000 B.P. and again at 3,300 B.P. Significant periods of deforestation have been detected in the Neolithic and subsequent periods at 3,900 - 3,700 B.P., 2,600 - 2,100 B.P., 1,700 - 1,400 B.P. and 400 - 300 B.P. There is a gap between the youngest 'Obanian' finds at 5,000 B.P. and the main Neolithic clearance in the district, which corresponds to the first in the above list. Evidence has been obtained from recent work on the peat deposits of Glen Shellach which shows rapid expansion of grassland, some cereal pollen and the appearance of the weeds of cultivation, but studies are not yet completed (Macklin *et al.*, 1991). In the absence of parallel work on the Ardentallen bogs, we can assume a similar sequence of events here, although the main clearance with grazing and/or cultivation may have been postponed until Iron Age times around 2,500 B.P. (see Table 1).

Once cultivation had begun on the better soils, it would have continued until the middle of the present century. The heavy slate clays, however, may only have been briefly cultivated (page 38). The high forest left on steep, rocky slopes would always have been husbanded for timbers, fuel and shelter, and the hazel woodland on escarpment edges cherished for its nut crop. Had the densest forest and woodland not been protected against stock and over-exploitation, it could hardly have survived to the present day in spite of the longevity of the oak. It is sad that the remaining fragments are now largely moribund and no longer regarded as an asset.

Recent Times

Resuming the inventory of structures to be seen on the ground at Ardentallen; there are two rectangular house foundations on the hill-grazing above the wood, but it is impossible to date them in the absence of associated artefacts or charcoal (Figure 5). It seems most likely that they belong to comparatively recent times - perhaps last century.

One other house site, with surrounding garden dyke, has been disturbed by the ploughing carried out in connection with conifer planting in 1963 along the road between Lower Ardentallen and Caladh. This could be contemporary with the ruins on the hill, and perhaps associated with the adjacent slate quarrying. Unlike the other sites, it has been indicated on the Ordnance Survey six-inch map of 1871.

Table 1

Stratigraphic zone	Climate period	Years BP (thousands)	Archaeology	Vegetation
I	Perth	17-13	-	Ice
II	Allerod	13-12	-	Tundra-birch scrub
III	L. Lomond	12-10	-	Periglacial
IV	Pre-Boreal	10-9	-	Birch-juniper-hazel
V*	Boreal 1	9-7	Mesolithic	Birch-hazel-(pine)
VI	Boreal 2	7-6	Meso.-Neol.	Oak-elm-hazel
VII a	Atlantic	6-5	Neolithic	Oak-elm-hazel-alder
VII b*	Sub-Boreal	5-2.5	Bronze	Oak-elm-hazel-alder-ash
VIII	Sub-Atlantic	2.5-	Iron	Oak-elm-hazel-alder-ash

* Post-glacial climatic optima?

Figure 5

One of the two rectangular house foundations on the Ardentallen side of Minard Glen. The figure is sitting in the doorway. The far slopes (Oban basalts) beyond the road to Minard lie on Lerags Farm.

Other pre-improvement dwellings may have existed on the site of Lower Ardentallen.

Quarrying

Quarrying of the Ardentallen sandstone possibly began in medieval times, since stone of this provenance has been identified in the walls of the surrounding Lordship castles. Quarrying certainly continued into the 19th century, and stone from here was used in the construction of the Caledonian Canal and certain buildings in the town of Oban.

Slate quarrying would have been a more recent development, and begun after the establishment of the documented working at Easdale and the other slate islands (possibly about 1626). It is also likely that the great storm and high tide of November 1881 brought an end to the Ardentallen working at the same time as the quarries at Easdale were flooded. The grass-covered slate spoil on the shore at Sailean Ruadh marks the position of another former water-filled quarry hole, which was back-filled late last century supposedly following the tragic drowning of two young children.

The best feature remaining at the Caladh quarry is the well-built quay, which could still be used, at the deep water channel connecting inner and outer lochs. No documentation from the days of quarrying at Ardentallen has survived, and there are no ruins which can be associated with the industry - only a few formless heaps of stone. There must at least have been crude lean-to shelters of some kind, and probably a smithy using locally produced charcoal rather than imported coal or coke from the Clyde.

Charcoal

Tree felling for charcoal production was certainly not carried out systematically on rotation at Ardentallen, as it was in so many of the surrounding Argyll woods to supply the furnaces at Bonawe and Lochfyne or the powder mill at Kilmelford (but see page 71). There, is likewise, no evidence of clear felling within the last 250 years, despite the documentary evidence that a "supplementary contract" for this very thing was drawn up between the estate and the Lorn Furnace Company in 1793. Charcoal making here must have been restricted to the utilising of lop and top from oaks felled for their structural timbers, supplemented by groups of hazel

poles. Again, little systematic hazel coppicing has been carried out within recent times as it was, for example, on the Raschoillie slopes of Glen Shellach.

Hut Platforms

Seven 'recessed hut platforms' (four of which found later use as charcoal stances) have so far been identified at Ardentallen. Two of these lie in the outer woods, and the remainder between Ardentallen Point and Sailean Ruadh. One of the latter, just outside the present woodland margin, has been radially trenched and has yielded such a quantity of lump charcoal in such a depth of blackened soil that it must have been repeatedly used by the colliers. A second platform within woodland showed evidence of having been built up with flat slabs of rock on the downhill side, but stripping of the turf revealed only scattered charcoal fragments and two patches of blackened soil. Neither site produced any evidence of post holes.

According to Rennie (1994), almost 2,000 of these platforms have been identified from Cowal and Bute north to Lochaber and Ardgour. All so far excavated have yielded signs of having been the sites of timber-framed huts, and most have later been employed as charcoal stances. Charcoal thought to be associated with the hutments, and not with the later charcoal production, has given an extraordinary range of dates, with the majority between 1,500 and 500 years B.P. While the slender evidence from Ardentallen does not preclude the platforms from being within this range, it seems most likely that they are the sites of lean-to shelters or bivouac tents used by the forest workers of the 18th century and perhaps by contemporaneous or later charcoal-burners from the quarry. The use of recessed platforms, rather than the numerous naturally level sites, could perhaps be explained in terms of desired shelter or the demands of the lean-to construction. A broken clay pipe has been found in the surface soil 140 m from one of the inner wood sites. Apart from a group of some five platforms reported from across Loch Feochan between Barandromin and Knipoch, these are the only such structures in the immediate vicinity of Oban, although they are plentiful to the east and the north along Loch Awe and Loch Etive.

Tracks and Dykes

Only the tracks and dykes of the area remain to be described (Figure 6). Three lines of turf or feil dykes traverse the hill ground, meandering so as to connect steep slopes and rock faces. These sometimes possess a core of aligned boulders but, where boulders were not immediately available, they have been constructed of turf alone. Here and there, two large boulders, usually granite erratics, flank a gap

in the dyke and may have marked simple gates closed with hurdles or brushwood. One of these transverse dykes can still be seen to end at the present march dyke, now fenced in addition, on the Lerags side. Another meets the old dyke built to demarcate the original farms of Ardentallen and Lower Ardentallen, and which subsequently replaced it *en route* to the Lerags march. This turf dyke, and the third of the transverse turf dykes, begin on the upper corners of the central woodland enclosure, which was probably of turf construction originally but is now largely ruined stonework. The third runs from the south-west corner of the enclosure across one of the high ridges at 90 m above sea level to end on a cliff top above the outer woodland. It can be picked out again at the base of the cliff as a crudely-built stone dyke running the short distance remaining to the shore rocks. A fourth turf dyke can be traced from the present garden ground of Lower Ardentallen to the top of a crag on the woodland edge to the east. Once again, this is continued through and below the woodland to the shore as a rough line of boulders. The four turf dykes are shown as dotted lines on the accompanying map (Figure 6).

The turf dykes have been cut through in several places by later generations to allow water discharge from hill drains. This implies that either the hill was less waterlogged in the days of functional turf dykes, or the people of those days were not concerned with drainage of uncultivated land. Turf dykes are widespread in the district and have been well documented on Kerrera. Those on Ardentallen are probably no later in construction than the mid-17th century and, when heritable title to the land was granted by the crown in 1680, they appear to have been replaced by crudely-built stonework, which mostly took a straighter line across the broken ground. A boulder dyke of this period runs parallel to the coast from the dyke separating the two former farms, to cross the fourth of the old turf and boulder dykes at right angles close to Caladh. Any former continuation in this direction cannot be made out, and the same is true for the southern end of the first turf dyke mentioned above. Oak and sycamore trees, 150-250 years old, are rooted in the stone dykes of this period but not in turf dykes nor in later stonework.

The third and last phase of dyke construction probably began late last century. At this time a professional dyker held the tenancy of an adjacent property at Ardoran, so he may have been involved. Only short lengths of the old dykes were rebuilt to professional standard, the longest being the one which separated the two farms, with the new work ending abruptly some distance short of the Lerags march dyke on the earlier alignment. The reconstructed dykes were probably initially capped with turf to increase their height, but, when drawn wire became available, iron uprights were leaded into granite boulders placed at intervals along the top

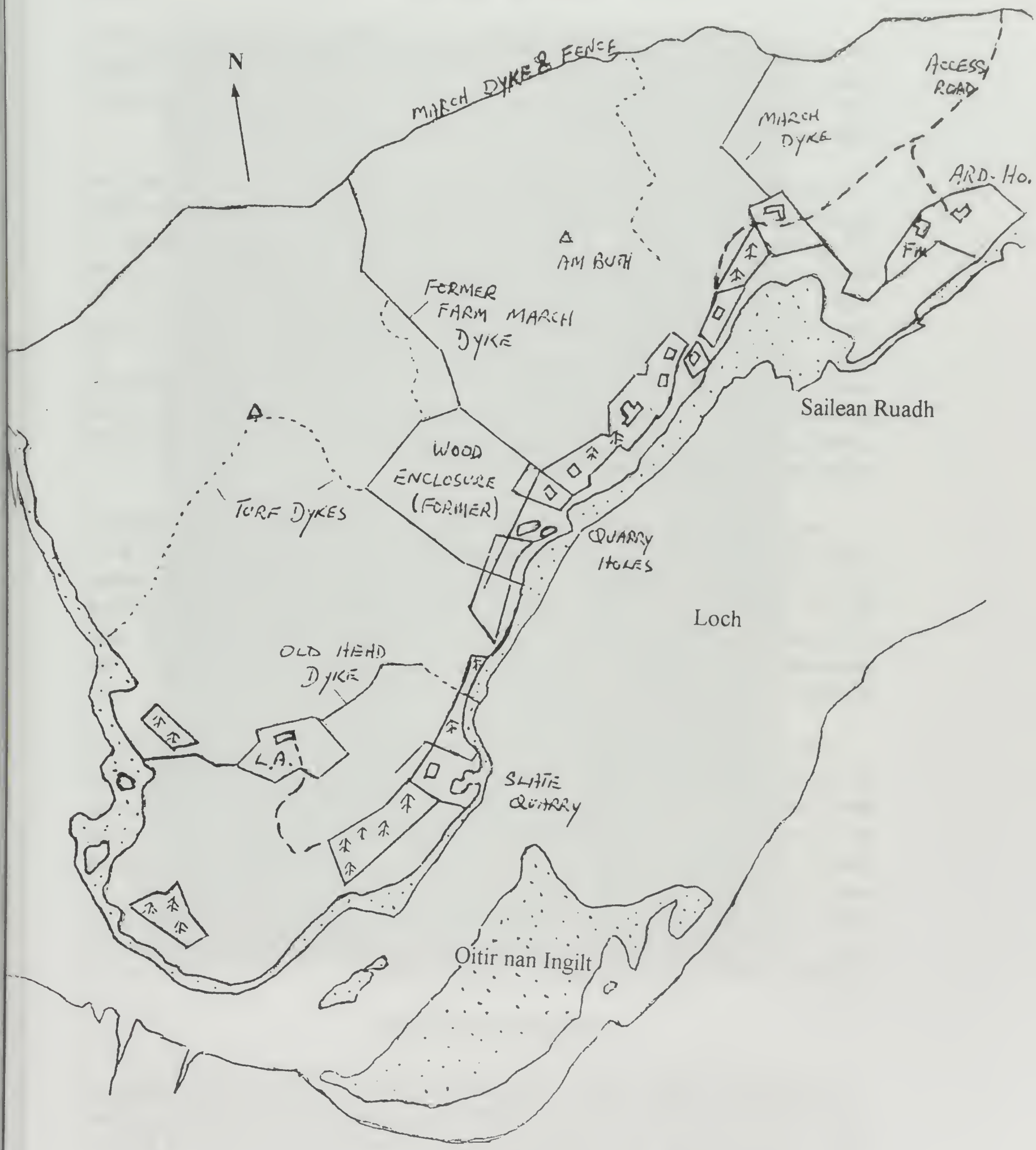

Figure 6

General map of Ardentallen; showing dykes and enclosures.

Scale c. six inches: one mile

and strung with two wires and flat iron droppers. As these, in their turn, began to require repair later this century, they were patched up with fence stobs and stapled wire. These have now rotted away, but the best sections of all three dyke styles remain in a remarkably good state of preservation (but see page 86).

The earliest tracks into the peninsula can still be seen in places, and the best preserved sections lie above the present road alignment beyond Ardentallen Cottage (but see page 86). The main track to Lower Ardentallen lay along the shore just above high water mark, and is either obscured by the present surfaced road or has been obliterated by the sea. The hill track diverged from this at the old slate quarry near Ardentallen home farm, and provided the access to the cottage before running along the slope below the sanatorium hollow (Figure 7). It ascended and descended several spurs to avoid marshy ground. These tracks are indicated on the 1871 map, but further traces can be distinguished beyond the sanatorium where cuts have been made into the steeper slopes both west and east of the enclosed woodland (but see page 86).

There is a puzzle concerning the old dykes. At some stage, the head dyke of the woodland enclosure, which had been built as a stone revetment with outer ditch in the manner of the old English enclosures, was rebuilt with sandstone slabs rather than the former irregular andesite blocks. The sandstone must have been sledded or carried on pony back from the outcrop at sea level, and the old hill track mentioned above must have been used for this since it passes close by. The transition from sandstone to andesite construction is abrupt at both ends.

Areas of recent cultivation, which are not immediately obvious today, covered the present garden ground of Sonas, and also the ground between Caladh and the south-east end of the adjacent spruce and larch plantation. In pre-farming days, the cultivation may have extended as far north as the main transverse dyke, and this would help to explain the extension to this point of the older rough dyke, running parallel to the shore below the wood, whose only other function would be that of a bottom enclosure dyke. This would also be in keeping with the impression on the ground that this dyke is older than the onset of the main period of sandstone quarrying, which is also hinted at by the map of 1871.

FARMING HISTORY

In the 17th century there were probably four or five families living on Ardentallen, carrying out runrig cultivation on all cultivable land, and herding their small cattle and sheep out of the crops and such patches of woodland as they valued. The livestock would also have been housed at night and in winter during

Figure 7

The old track from Ardentallen Cottage which predates the 1871 map. The track is 2.0 m wide, and is paved in this section like a pack-horse road. Note accumulation of stony debris from the eroding slope to the right. [This was destroyed by J.C.B. excavator in March 1996; see page 86]

inclement weather. Crops grown from the earliest times would have been flax, bere and bristle-pointed oats, with latterly improved oats and barley and finally potatoes. What happened to these people after Donald Campbell of Lochnell became the first heritor of the estate in 1680 it is impossible to say, but some may have remained as labourers on the land or in the quarries. The land was probably divided into two working farms of equal size early in the 18th century, with the low ground arable land divided equally between them. There is no sign of the badly-drained clay land around Ardentallen Farm having been cultivated in pre-improvement times, but improved ploughs and stronger work horses, along with tile drainage, would have made this possible. At the same time, most of the old turf dykes were rebuilt in stone, namely the Lerags march dyke, the division between the two farms, and the head dykes of the inbye land (see Figure 6). The enclosure dyke around the central woodland was probably rebuilt about the same time, since two of the surviving transverse turf dykes can still be seen to begin at its two upper corners. However, there is no indication on General Roy's military map of 1750 that this woodland was enclosed at that time, although it is clearly marked with a cluster of tree symbols (see Figure 1).

There is hearsay evidence that up to the end of the two farm tenancies after the second World War, the tenants were not allowed to cut standing timber but were restricted to the gathering of dead wood for their fuel. Peat was taken from the deep bog hole behind Lower Ardentallen until the turn of the century. Timber was certainly cut, presumably by the estate, and some charcoal must have been made, although there is no local memory of this ever having been done. Main stem timber would have been exported for crucks and other structural members in building work. Older sled tracks from the runrig days may have been used and extended for the timber work. The presence of hut platforms hints that outside labour was employed, at least in part (see also page 33).

Stocking rates are known only for this century and they have remained essentially the same throughout, in spite of the obvious deterioration in the grazing quality. Lower Ardentallen Farm is known to have carried 110 sheep, with a dozen milking cows and followers and two or three draft horses, before the first World War. The ground has carried both cattle and sheep, with the exception of the period from 1939 to 1942 and again from 1978 to the present day when only sheep have been stocked. Potatoes are known to have been grown on Ardentallen Farm until 1948, and the last cereal crop at Lower Ardentallen was undersown to form the improved grassland between the farm and Ardentallen Point about the same year. Liming and slagging of the hill ground was carried out mechanically in 1944-45, and this could have been the first general application of fertiliser here since the seaweed and shell-sand of runrig days. There is, incidentally, still a good

source of shell sand (more correctly barnacle sand) at low water in the tidal narrows between the inner and outer lochs.

Farming, as distinct from cattle and sheep ranching, came to an end shortly after this, and in 1946, when Ardentallen House and Lower Ardentallen were both sold, a new division of the property was made, by agreement between the two purchasers, along the old inbye dyke between Ardentallen Cottage (formerly the gardener's house) and the Lerags march. Grass burning on the hill ground may well have been carried out throughout the farming era, but it is unlikely to have been a management tool before then. It is on record that one fire burned through the woodland from Ardentallen Cottage to the 'sanatorium' one dry spring during the early 1940s and it is doubtful if any special care would have been taken latterly to prevent fires from running at least some way into the woodland margins. Cessation of careful and regular burning, combined with the liming and slagging at the very end of the farming era, must have contributed to the increased rate of whin colonisation, which has taken place over the last fifty years concurrently with the extension of bracken.

With the two farmhouses and steadings thus alienated from the land, the entire peninsula was let to a succession of grazing tenants, with sheep and Galloway cattle in the 1950s and the Galloways replaced by a nondescript suckler herd in the 1960s and 1970s. In the early 1960s, five small spruce and larch plantations were ill-advisedly established along the main post-glacial shoreline, partly on marsh and partly on former arable land and, at the same time, five building plots were feud between the two existing cottages, thus effectively obliterating any features of geological, archaeological or botanical interest which may have existed on the sites. Two interesting plant species, *Saxifraga hypnoides* and *Geranium lucidum,* have so far contrived to survive on the boulder talus at the rear of one garden, but a few plants of *Lythrum salicaria* had to be rescued from one of the spruce plantations as it closed canopy. In 1984 an attempt was made to control the hill bracken by aerial asulox spraying, but this was completely ineffective due to the broken and partly wooded topography. In 1986 the present woodland rehabilitation scheme, combined with some bracken control by hand-cutting, was initiated, and in April 1990 sheep were excluded from some 1.5 ha of the floristically-rich central woodland by means of high tensile stock fencing. This includes the larger part of the original enclosed woodland.

The present use of the area, in common with that of much of upland Scotland, leaves a lot to be desired. At 230-250 breeding ewes and gimmers overall, the stocking rate is as high as it has ever been, and is equal to what has been traditionally regarded as the limit for the best hill land of Argyll. In effect, over

two-thirds of the area now consists of fenced garden ground, plantation and conserved woodland, scrub without a grassland floor (see page 77), dense bracken thatch, whin thickets, wet moorland and rush-covered bog. Perhaps one quarter of the area carries bent-fescue grassland with a thin bracken cover in places, or former improved grassland now deteriorated. This amounts to gross overstocking, except for a short period covering most of May to September, when the sudden summer flush of grass allows a further 200 or more lambs to be carried and still leaves a small surplus in the form of 'standing hay'.

At the same time the woodland is largely moribund and is dying at a steady rate. A significant contribution to sheep forage is still being made by tree branches below the browse line, wind-blown shoots and leaves, fallen branches at all times of year, autumn green leaf fall from ash and hazel, as well as whin and willow scrub and all tree seedlings. The best grassland is on areas of former cultivation, and where slopes are naturally and seasonally irrigated by seepage water from lime-rich rocks. These areas are hard grazed throughout the year, and are noticeably bare even at the start of winter. There is little peaty surface run-off. In a mild winter, young rush and iris shoots form an important part of the diet, and in autumn nettles and male fern are readily eaten along with frosted *Galium aparine*, marsh thistle rosettes, and a wide range of 'weeds'. The use of Rumavite blocks in late winter and early spring leads to an even greater intake of fibrous forage, including bare twigs and branches of all kinds, and to some bark-stripping of live willow, rowan and ash. Since ruminal bacteria can digest only the cellulose but not the lignin, the use of these blocks for sheep with access to woodland must result in filling without fattening. Under such a grazing regime the less common species of plants, which are seldom numbered among the distasteful ones, are destined to rapid extinction (see later section on Sheep and Floristic Impoverishment).

In the winter of 1994-95 the Ardentallen sheep were observed to add more fruticose and foliose lichens to their diet, particularly species of *Usnea* and *Ramalina*, although species of *Evernia* and *Lobaria* were also eaten. One thicket of *Prunus spinosa,* which was mostly dead and smothered in *Usnea,* was smashed to the ground and all the finer branches with their loads of lichen were consumed. Sheep, whose diet ranges from acorns to lichens, by way of nettles, trees and garden plants, are known in the trade as 'good foragers'.

VEGETATION OUTLINE

The vegetation of the main woodland will be dealt with in the following section. There is little in the grasslands, marshes, bogs and wet heathland that is in any way exceptional or of much interest. The three largest volcanic 'vents', including that

with the central watercress spring, may have carried small areas of interesting bog types at one time, but peat cutting, burning and grazing have greatly modified them. In the same way the marshland with *Carex rostrata* and *Menyanthes* in Minard Glen may also have been of greater interest formerly, especially if it is indeed a relic of former vegetation marginal to open water (page 21).

The main vegetation types can be dealt with in summary fashion:-

GRASSLAND

Improved Mixed grassland of former cultivation, with marginal bracken, thistle invasion and rush infestation where drainage has deteriorated. Species such as *Cynosurus cristatus, Lolium perenne, Dactylis glomerata, Poa pratensis* and *Trifolium pratense* are still frequent.

Unimproved Mixed bent-fescue grassland covering a wide range in fertility, with *Anthoxanthum odoratum, Danthonia decumbens, Holcus mollis* and *Trifolium repens.* There is much invasion by bracken, rush, iris and creeping thistle. No hard and fast distinction from the improved type can now be made.

Naturally irrigated (**'flushed'**). As for the previous types, with *Carex panicea, Alchemilla glabra, Poa trivialis* and a wide variety of other species indicating better calcium status. A favoured grazing type at all seasons, so that it is difficult to obtain a complete species list.

Peaty grassland Mixed bent-fescue with much *Molinia caerulea, Nardus stricta, Scirpus caespitosus* and other bog species. Mostly on the higher areas. Some examples are rich in depauperate heather and if ungrazed and seldom burned might develop into wet heather moorland.

Tussock grassland Dominated by *Deschampsia caespitosa* with *Molinia* and rushes. An opportunist coloniser of wet and bared ground. Tending to spread at present.

BRACKEN-DOMINATED LAND

Bracken grassland With bent-fescue if not too dense and *Holcus mollis* in the denser stands. Some woodland clearings and edges have a richer, part-woodland flora with bluebell, primrose, meadow sweet, woodruff, *Mercurialis* and even *Ophioglossum* in one locality.

Bracken only Thick bracken-litter thatch below seasonal live fronds with scattered *Galium aparine,* nettle and bramble. *Arctium minus* and *Corydalis claviculata* are also present and on the increase.

BOG / WET HEATH COMPLEX

Rush bogs *Juncus articulatus - J. acutiflorus* with patches of *J. effusus* and *Polytrichum commune.* All transitions to peaty grassland occur. At all levels.

Cotton grass bog *Eriophorum angustifolium - E. vaginatum* with *Sphagnum* spp. rushes, grasses, *Polytrichum*, and depauperate heather, blaeberry and *Erica tetralix.* Confined to the higher ground.

Flag iris bog *Iris pseudacorus* with rushes and some *Glyceria fluitans.* Mainly on the raised beach and wet areas of the lower slopes.

Sphagnum bog Small areas completely dominated by the bog mosses with *Drosera longifolia* and some *Pinguicula vulgaris.* A wider variety of bog and marshland species can also occur where there is some soligenous drainage water, e.g. *Selaginella selaginoides* and *Linum catharticum.*

Saltmarsh turf A dense mat of *Puccinellia maritima, Armeria maritima, Plantago coronopus* with *Triglochin maritimum, Cochlearia officinalis,* etc. The tiny brown seaweed *Fucus muscoides* may be dominant to form dense brown turf. Mainly at Sailean Ruadh; patches elsewhere.

Whin scrub Substantial areas of whin scrub occur above the woodland in grassland and bracken ground, but these have little influence on the floristic composition of the vegetation except where dense enough to produce almost bare ground. Sheltering sheep assist this process. The whin thickets are essentially cyclical and may be seral to woodland if colonised by tree seedlings at the critical phase (Figure 8). Otherwise the ground usually reverts to the vegetation originally present following senescence and disappearance of the scrub.

THE WOODLAND

General Description

The Ardentallen oakwoods are like many others in Argyll in being strung out on steep slopes bordering arms of the sea, avoiding the marshes and bogs of the main post-glacial shoreline and hardly extending onto the exposed grassland and moorland above the glacial oversteepening of the lower slopes (Figure 9). They have been found to show greater than average variety in both structure and species of plants present. Most of the Argyll oakwoods result from a uniformly-aged growth of coppice stems from the days of rotational felling to feed the iron furnaces of Bonawe and Lochfyneside. These have lost most of their understory trees and shrubs in the process and subsequent decades of sheep and cattle grazing have produced a woodland floor of either grass and bracken or various mixtures of grass, deep moss and blaeberry according to soil characteristics. The Ardentallen woods, on the other hand, have three core areas of tall unfelled trees in close canopy with an understory of hazel, occasional rowan, sallow and hawthorn (Figure 10). The core areas are embedded in hazel woodland and scrub with scattered pioneer oak and ash or in hazel scrub with few emergent trees (Figure 11). Some of the hazels have been well grown, reaching close to the maximum height and stem diameter recorded in the British Isles, but are now mainly moribund with rotting main stems surrounded by sheafs of natural stool shoots. Scattered oaks or groups of oak are coppice shoots rather than original stems, which indicates a certain amount of past utilisation (Figure 12).

The woodland limit rises from 50 m above sea level on the south-west side, facing the Firth of Lorn (Figure 13), to almost 90 m on the steeper north-east side, facing up Loch Feochan. The undulating summit ridge or plateau, which just exceeds 90 m in three places, is exposed in all directions but principally to the west and south-west, and wind speeds are greatest along the break of slope on the woodland edge.

Sheltered pockets exist on the plateau, and these carry scattered hazel and stunted oaks. The woods of the outer loch have a greater admixture of ash but are now becoming open and rather derelict. The inner woods are denser, with fewer ash but more elms. Inner and outer woods are almost separated by the old cultivated land and recent conifer plantings around Lower Ardentallen, with a separate patch of oakwood on the high ground of Ardentallen Point.

Two of the core areas just mentioned have an essentially grassland floor of bent-fescue with scattered bracken and male fern (Figure 10). The third has a

Figure 8

Young birch colonising in shelter of whin thicket, just above woodland margin at 85 m above sea level.

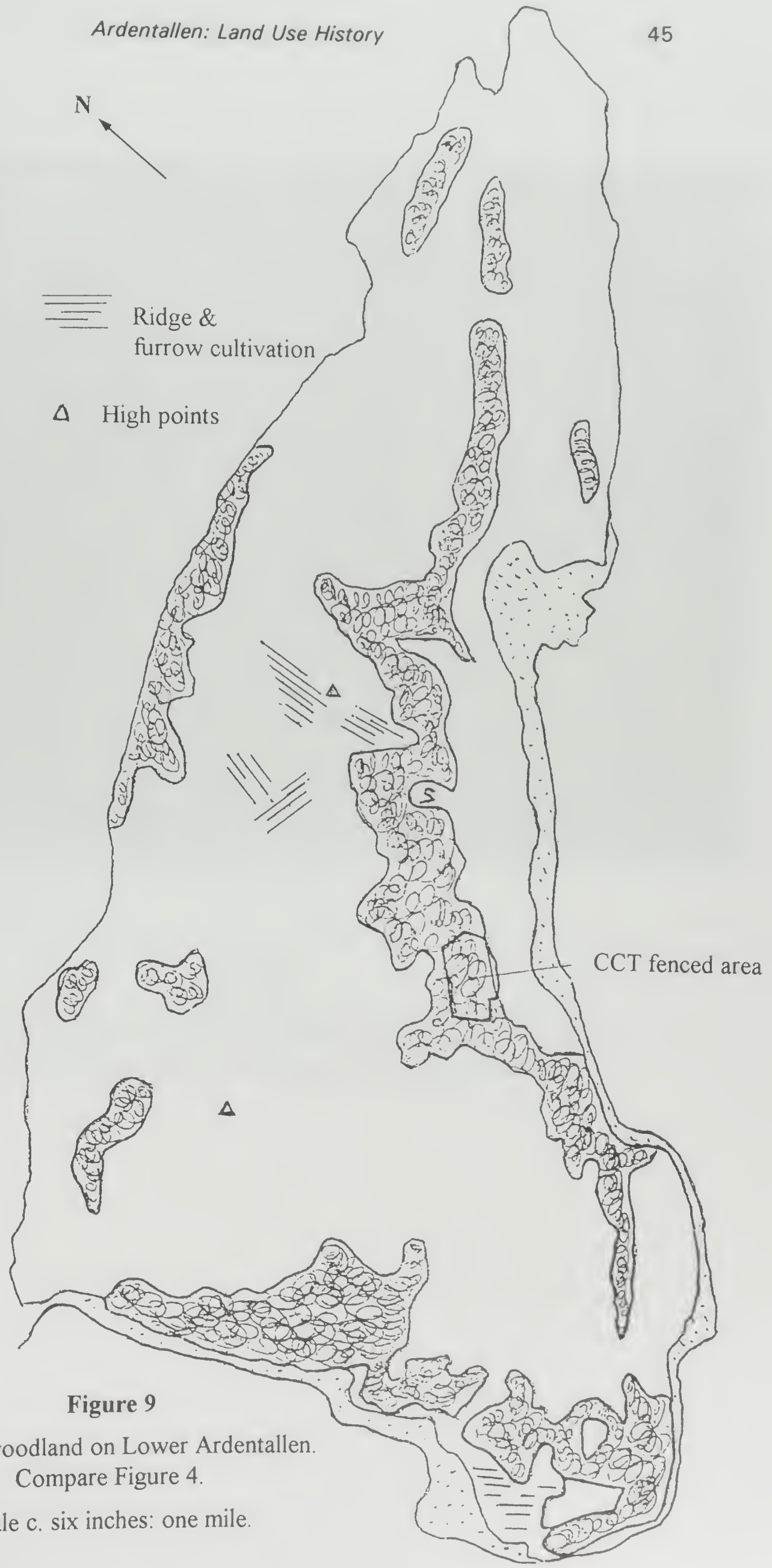

Figure 9

Present woodland on Lower Ardentallen.
Compare Figure 4.

Scale c. six inches: one mile.

Figure 10

Northernmost group of uncoppiced oaks in close canopy. There are a dozen large trees about 250-300 years old, with a few understory hazels. Surrounded by hazel woodland with emergent pioneer oak and ash.

Figure 11

Typical uncoppiced hazel scrub woodland.
There are a few natural stool shoots and no large trees.

surprisingly species-rich field community of tall grasses, such as *Dactylis glomerata, Brachypodium sylvaticum, Deschampsia caespitosa* and *Bromus ramosus,* with abundant *Melica uniflora, Allium ursinum, Mercurialis perennis* and *Hypericum androsaemum.* This will be described in detail later. There is also a limited area of deep moss with blaeberry and *Deschampsia flexuosa* under more stunted oak, with birch and rowan but lacking hazel, ash and elm. The species-rich sector may once have extended to the south-west on less steep ground, but this has easier access for animals and may never have been enclosed like the main area so that it is now virtually grazed out.

The largest oaks are in the core areas, and reach heights and stem diameters around the maximum recorded in the west and central Highlands, although they are now becoming stag-headed. Some of the pioneer oaks outside the cores are also large, although not very tall, trees. It is difficult to say whether or not they are the same age as the close canopy oaks. The best approximate annual ring counts which have been obtained from felled coppice stems give ages around 150 years old at time of felling their boles, and hence the stems of uncut trees are probably around 250-300 years. Some large trees could be considerably older. Where coppice shoots are able to survive the attentions of browsing animals, both wild and domesticated, seedling regeneration is also possible, so that some of the smaller single stems may belong to a 150 year generation. A still younger generation of around 100 years (estimated by stem diameter, and position in relation to parent trees) has been noted among oaks at the head of Loch Feochan where they are scattered around the crowns of 250 year pioneers. This is not seen at Ardentallen, but some of the smaller trees on the woodland margin may be as young as this. There remain about eight young trees, thought from their size to be around forty years old. Most of these occur close to the present road, and some have obviously grown within a protecting thicket of blackthorn or whin, along with young ash. It seems likely that all belong to the same minor episode of oak regeneration but the reason for this has not been found, although it may cover a period of some ten years with more cattle and fewer sheep on the ground. Several small and contorted oaks on the margin of the outer woodland appear to be even younger, but could belong to the same age group and have suffered more than usual damage. These localities are also very exposed and tend to be avoided by the sheep, especially in winter, so that regeneration might be easier here although any surviving saplings still have to suffer much browsing after emerging from protecting vegetation (Figure 13). Patches of birchwood along the northern march and around Lower Ardentallen could also have originated in these relatively sheep-free times around forty years ago. Indeed, there is evidence throughout mainland Argyll and further afield of an era of regenerating woodland which coincided with a period of hill farming recession.

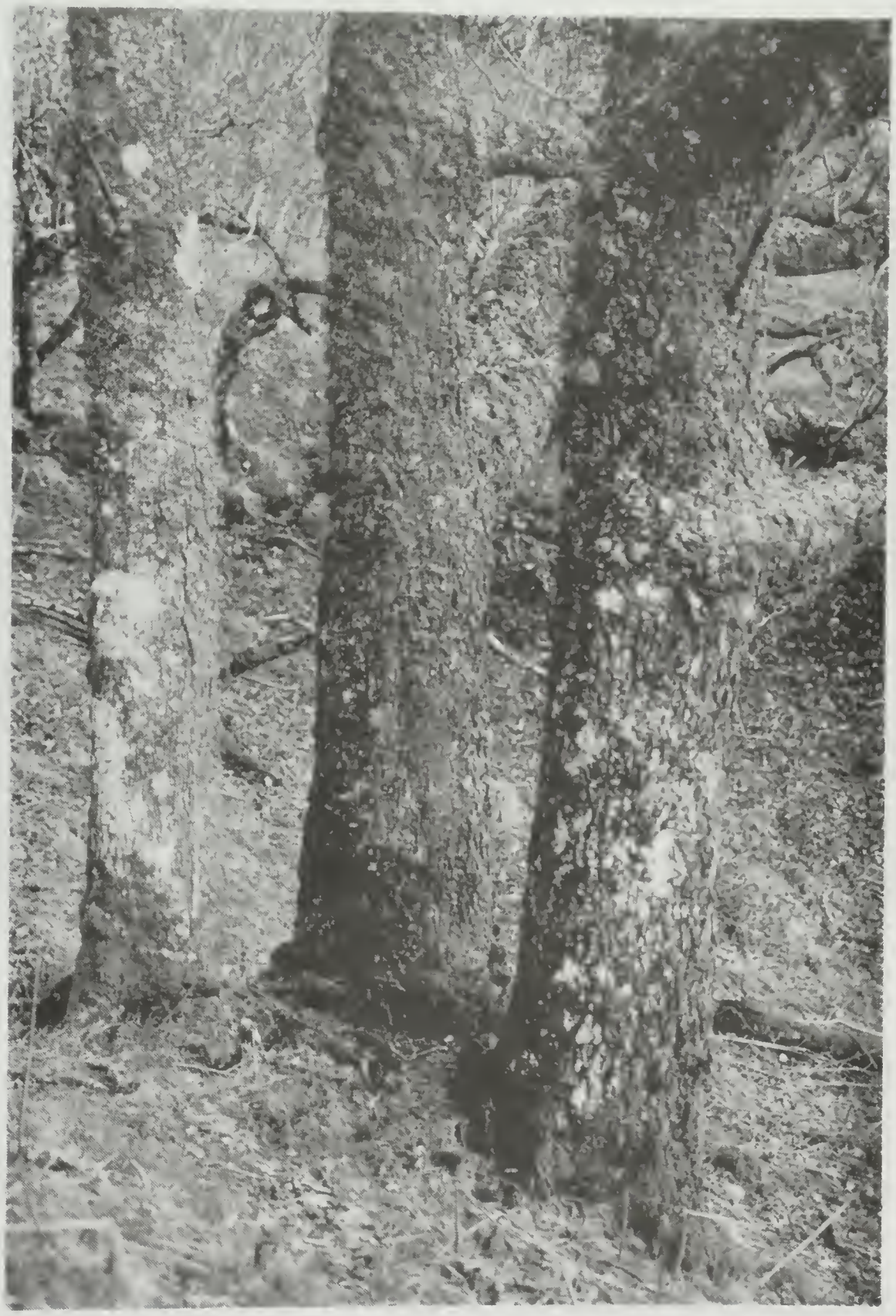

Figure 12

Group of well-grown oak coppice stems, probably 200 years old.

Figure 13

The woodland edge on steep slope at 70 m above sea level, looking towards Ardentallen Point and the fluvioglacial terraces of Kilninver beyond. The figure is standing in a patch of oak regeneration crippled by repeated grass fires, sheep browsing and exposure. One oak of unknown age has finally grown above the browse line.
Now destroyed by moor-burning.

The Ardentallen oaks are almost all pedunculate (*Quercus robur*), although a few seem to be pure sessile oak (*Q. petraea*) and quite a number combine the characters of both so that there could have been some introgressive hybridisation. There is no question of the pedunculate oak having been planted here - as it has been in some districts - and, indeed, the high calcium and clay content of the soils would lead one to expect this species to be the natural occupant of the area. The sessile oaks and the probable hybrids appear to be scattered at random, and there is definitely no segregation of the former on the more acid andesites. The sharp transition from species-rich woodland to heath woodland within the formerly enclosed area is not accompanied by a change in oak species, which is entirely pedunculate on both sides of the geological fault responsible for the contrast in rock type and lime content of the soil (Figure 14).

Phytosociology of the Fenced Area

This small area of some 1.5 ha contains three distinct woodland types, with a remarkably sharp transition between the two most distinctive. It was, however, recognition of the exceptional quality of the species-rich mixed oak woodland of the steep (45°) central slope which finally brought about the decision to exclude sheep in 1989. In this section, which lies below crags of agglomerate and calcareous volcanic tuff, the stony soil is well supplied with calcium and, being south-facing, receives extra warmth in winter and early spring. It is, on the other hand, inclined to drought from April onwards if rainfall should be much less than average (Figure 14).

The woodland floor is a tall grassland with an open structure which allows room for several of the less common woodland plants. The overall dominant species is *Brachypodium sylvaticum.* Other important grasses are *Bromus ramosus, Melica uniflora, Dactylis glomerata, Deschampsia caespitosa* and *Arrhenartherum elatius,* with accompanying *Carex sylvatica, Allium ursinum, Asperula odorata, Hypericum androsaemum, Sanicula europea, Melandrium dioicum, Botrychium lunaria, Vicia sylvatica, Rubus saxatilis, Adoxa moschatelina* and *Cephalanthera longifolia* (Figure 15). Only one other closely similar type has been described from the west Highlands - in the Rassal Ashwood National Nature Reserve at Loch Kishorn in Wester Ross.

In the European context, the closest resemblance is with the grazed-woodland-margin facies of the Coryleto-Fraxinetum of Belgium and northern France. This belongs to the Carpinion betulae Alliance of Order Fagetaea sylvaticae of Class Querco-Fagetea (broadleaved deciduous forest of lime-rich soils).

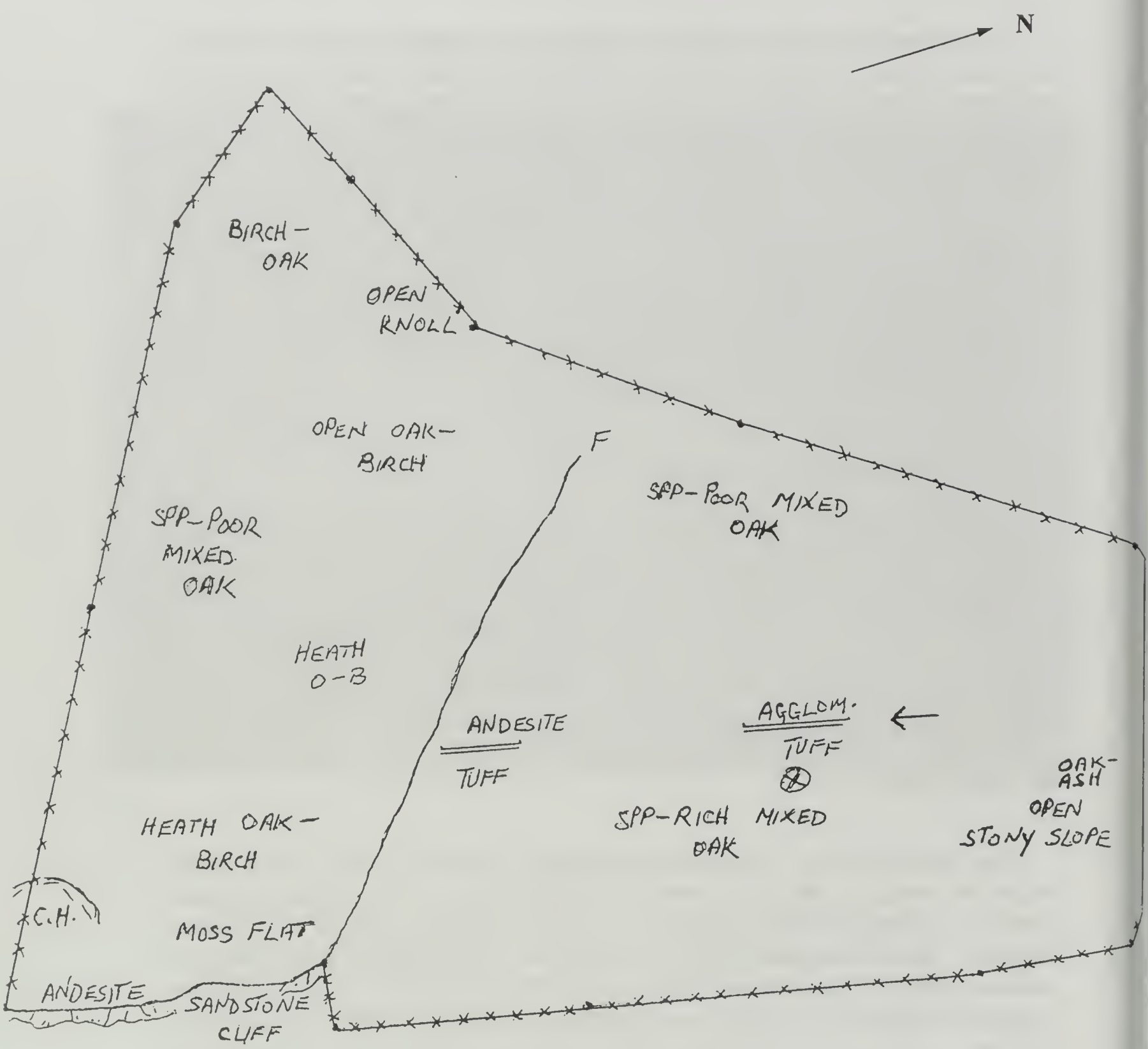

Figure 14

Relationship of vegetation and geology in 1.5 ha fenced area.

Scale c. 1.0 cm : 10 metres.

F. Fault-line cliff

C.H. Charcoal hearth

← Upper tuff contact

⊗ *Botrychium* colony.

Figure 15

Flowering spike of *Cephalanthera longifolia* in fenced woodland. The number of flowers per spike can vary from three to twelve at this site. The plastic collar helps to reduce slug and vole damage, which can be severe in some years.

Within the fenced area a diagonal fault separates the calcareous tuff from the more acidic andesite lavas. Within a few metres the species-rich association changes to a species-impoverished oak-birch woodland lacking ash and elm and with little hazel. The woodland floor of the oak-birch is a deep mossy mat, with *Deschampsia flexuosa* as the dominant grass and with abundant *Vaccinium myrtillus,* scattered *Erica cinerea* and some *Calluna vulgaris.* Heathy oakwood is one of the common woodland types of west Argyll, and although it belongs to the Alliance Quercion robori-petreae (broadleaved deciduous woodland of acid mineral soils) the ericaceous element shows that it inclines to Class Vaccinio-Piceetea (coniferous forests on acid mor soils) in Europe. Both these communities give way uphill to a second species-poor oakwood type in many respects intermediate between them. This is again grass-dominated but *Brachypodium* is largely absent, *Melica, Bromus* and *C. sylvatica* disappear completely, and *Dactylis, Arrhenatherum, D. caespitosa* and the bent-fescue grassland elements take over. Bracken is also abundant and there is an increased amount of other ferns. Most of the *Cephalanthera* actually occurs in species-poor types, and since this was written, several *Cephalanthera* spikes have appeared well within the heath oakwood with no other calcicole species nearby.

Although sycamore is a common tree in the lower part of the fenced area its regeneration has not been a problem so far, as might have been expected. Bramble is the only species showing signs of becoming troublesome in future, but only within the species-rich woodland, although *Luzula maxima* is also becoming more prominent in many places. Several holly seedlings have also appeared since fencing was carried out.

WOODLAND RESTOCKING TRIALS

Programme

Present day lack of woodland regeneration is certainly not due to failure of seed production nor to unsatisfactory germination. Seedlings of oak, ash, elm, hazel, birch, rowan and hawthorn can be found in most years, although the fruiting of oak tends to be spasmodic, as it is elsewhere. Elm seedlings occur only in the woodland near parent trees while small saplings are found only on crags and steep rocks, but all other species occur either in the woodland or in the open in suitable places. The holly seeds are brought in from some distance by birds, since the few hollies occurring on crags in the outer woods are stunted and rarely produce many berries.

With very few exceptions, seedlings of all species are quickly browsed by sheep, either incidentally along with other forage when the seedlings are small in their first year or two, or deliberately when they have grown large enough to attract attention.

An experimental programme was started in the autumn of 1986 to determine how easily the seedlings could be saved by the use of plastic tree guards, recently introduced by Mr. Graham Tuley of the Forestry Commission, without the need to exclude sheep by fencing. To begin with, any hazel, rowan, oak or birch saplings which had survived for a few years and could be spotted were drawn erect and tubed or staked according to height. There were not many of these, although a few kept turning up in most years, and only some four or five oaks have ever been discovered which were worth saving, almost all in dense bracken. At the same time, a small number of one and two year old nursery-grown oaks and elms were planted out in each of the first two years. This conventional procedure served as a yardstick by which to measure the progress of the more experimental work. In 1987 and 1988 a number of small patches of 30-50 sq. m, both within and outside the woodland, were selected where tree regeneration was particularly dense, and these were fenced with recycled rabbit netting, old stobs, spruce tops and anything else suitable which was available. This makeshift fencing excluded the sheep quite adequately for five or six years, and enabled the otherwise unprotected seedlings to act as controls, for the tubed trees. In the autumn of 1992, one of the Swaledale ewes developed into an habitual fence breaker and put an end to the use of these as controls, although many of the trees made a good recovery from damage (see page 56). The various plots were as follows:

Plot 1. Dense birch seedlings near woodland edge resulting from moor burning. One rowan and one hazel also present. A few oaks planted or sown direct.

Plot 2. Mixed oak, ash and hazel seedlings in woodland clearing with one planted holly.

Plot 3. Mixed oak and ash with hazel and rowan and two planted hollies on fine scree slope under light tree canopy.

Plot 4. Scattered birch and oak with a few hazels and rowans on open hill spur on woodland edge. Extra oaks sown direct.

Plot 5. Dense *Salix aurita* with scattered birch on wet heather slope above woodland.

Plot 2 had to be abandoned after two years due to unexpected dense growth of nettles and *Gallium aparine*, but the best of the surviving trees were tubed and two of the largest ash saplings were self-supporting in their seventh year. Plots 3 and 4, at the time of their abandonment as controls, demonstrated that birch, ash, hazel and rowan are capable of growing above the sheep browse line in six years, but that oak, at only half this height at that time, would require a further five or six years of protection. Even some of the five year old birch in Plot 5 survived the incursions of the fence breaker. Although the 1.5 ha fenced area was set up at a later stage than Plots 1-5 (1990), mainly to protect the exceptional plant assemblage and vegetation contrasts found there, the effect of the sheep exclusion on woodland regeneration was also recorded and the area provided a younger generation of control seedlings.

Many lessons were learned from the early work with plastic tubes, some of purely practical importance but others throwing light upon the ecology of the various species. As well as the early establishment of nursery transplants and the rescue of naturally occurring seedlings, some reliance came to be placed on the direct sowing of oak. Natural oak seedlings seldom appear in situations where they are best able to succeed, nor do they take kindly to translocation in the field. Some direct-sown acorns were lost to mice and cutworms, and the most reliable results were obtained by germinating the acorns in small pots and planting these out just after the emergence of the plumule in April. This can be delayed until the first autumn, but tap roots tend to coil within the pots by then. By using all the above methods, work on woodland restocking can be spread pretty well throughout the year.

Another feature of the work was the recycling of commercial tubes as fast as possible, so that each tube could be used to protect a number of trees before degrading and becoming too brittle. The many tube patterns and plastic compositions vary in this respect, of course, and most are designed for early self-destruction. Cut-down clear and tinted plastic bottles of various types were also used for the initial seedling rescue, the plants then graduating to 2.0 ft and finally 4.0 ft tubes before untubing at around 5.0 ft in height. Tube-grown trees almost always require continued staking at this height, and plastic bags or sheeting are usually necessary to protect them from sheep browsing for a further year or so. This is particularly true of those species, such as hazel, which produce many side shoots within the tubes. Plastic wrappings also helped to discourage sheep from climbing the stakes with their forefeet in order to reach the leading shoot. Exceptionally, the heavier animals will use their weight to bend over self-supporting saplings and this can still happen with 7.0 ft trees due to the lasting effect of early forced growth in the tubes.

It was soon obvious that 4.0 ft tubes, unless completely untinted, are unsuitable for the smallest seedlings and that most commercial tree tubes transmit too little light to be used in any woodland shade. Even tinted 2.0 ft tubes may fail in this respect. Stout stakes on the outside of tubes encourage sheep rubbing, with consequent twisting of the seedling.

It should be noted in passing that while the large seeded species (oak and hazel) can be tubed as newly germinated seedlings, the small seeded species (birch, rowan, etc.) are best left for several years before any attempt is made to rescue the survivors.

Slender stakes inside the tubes are more satisfactory, provided they are robust enough. It was also apparent at an early stage that, in the latitude and climate of the west Highlands, oak is heavily dependent on receiving the maximum possible amount of sunlight to compensate for the generally low air temperatures and overall lack of accumulated day degrees in any growing season. Seedlings in clearings grew significantly faster on the north side, and it was even found inadvisable to plant or sow an oak on the north side of any shade-casting objects. It follows that steep north slopes are unlikely to form good sites for oak establishment and, indeed, few Scottish oakwoods are found on steep north slopes. This demonstrates that the immediate past climate has not been significantly warmer.

Another possible benefit of warm south slopes for the establishment of oak has been demonstrated at Ardentallen. By germinating acorns in soil-packed drain tiles in two separate winters, it has been shown that those kept under frost-free conditions at average temperatures 3.0° C higher than ambient produced primary roots much longer, and often considerably better developed, before the emergence of the plumule in April. While tiles exposed to the winter frosts, but not to direct sunlight, produced radicles averaging around 6.0 cm and up to 15 cm, depending on the severity of the winter, those at the slightly higher temperatures averaged 12 cm and could be up to 30 cm long. Furthermore, the longer roots were branched and had matured to a wiry brown, while the short roots remained unbranched, and were white and fleshy.

The difference in root development at the time of shoot emergence in the field (April-May) and during a spring or summer drought could be critical in determining the availability of moisture to the seedlings, and hence their survival over the first year. Plumule emergence also tends to be earlier from acorns kept at the higher temperatures, such as might be expected in the topsoil of steep south-facing slopes in sheltered locations.

Table 2

Time Taken from Germination to reach 4.0 feet in Tubes

		Years
OAK	Direct-sown or pot-planted in open	2-3
	Average two-year nursery transplants	4
	Good one-year nursery transplants	3-5
	Nursery plants in clearing on south margins	5+
	Nursery plants in clearing on north margins	6
	Natural undamaged seedlings on south margins	4-5
	Natural but damaged seedlings on south margins	7-10
Hazel	Natural undamaged seedlings in open	3+
	Natural undamaged seedlings in clearings in partial shade	8+
Ash	Natural, damaged and tubed at 10-30 cm	5

Note: Add at least two years to above ages to be self-supporting.

It should also be noted that the slowly growing seedlings in partial shade remain vulnerable to sheep damage for a longer period than the others, so that it is difficult to give a practical demonstration that trees can, in fact, be grown under these conditions. Few young trees in this category now survive.

The opposite effect can be observed with birch, the seedlings of which are subject to speedier desiccation on the sunnier slopes and better survival is assured where there is some topographic or side shade from vegetation. Strangely enough, for a shade-bearing species, the growth rate of hazel in tubes of any kind has not been satisfactory in anything less than full daylight. In the open, hazel will outperform oak, but in even light shade the opposite appears to hold good after the first few years because of dieback of unknown origin. Untubed hazel seedlings do not show this, and the hazel has still outgrown oak in shaded fenced plots. The effect almost certainly results from greater slug or insect defoliation of the shade leaves in tubes, since hazel cannot tolerate this in the way oak can.

Drums of rabbit netting on three or four stakes have also been found to protect seedlings efficiently, although they are more costly in time and money. The resulting saplings are more robust and spreading as a result of the unforced growth (also see note on ash). Eventually this protection also has to be extended in height, since some sheep quickly learn to use the netting as a stepladder so that they can browse almost to the same height as roe deer.

Damage to Seedlings and Saplings

Factors checking the early growth of oak seedlings and producing long periods of stagnation are many and various:

1. Browsing damage after plumule emergence, especially if repeated.

2. Anything less than full light intensity, especially absence of sun.

3. Presence of a dense grass turf, especially in the first few years.

4. Frost damage in May. Can occur to height of 1.5 m in hollows.

5. Growth of seedling on thin soil over bedrock. Partly a drought effect.

6. Caterpillar damage.

In common with oakwoods everywhere, the Ardentallen oaks are subject to annual attacks by defoliating caterpillars of many moth species. The breeding of woodland warblers and other small birds depends on, and is synchronised with, this annual event. Around the mid-1980s severe defoliation of western Argyll oakwoods occurred, and this was repeated for several consecutive years. The mature oak is adapted to this and responds by the production of a second crop of

shoots (lammas shoots), but when the infestation extends to other species such as birch and hazel, as it does in severe attacks, these species may be crippled or even killed. Ardentallen escaped the first few years of this last cycle, but in 1987, and to some extent in 1988, many oaks were completely defoliated and the infestation spread to the young trees of the experimental trials. Those in tubes were particularly badly affected, and this has to be borne in mind in assessing results. Periodic outbreaks of this kind are one of the factors involved in the paucity or failure of oak regeneration, since the caterpillars spin down on silk threads onto the young trees below and can also be blown to nearby regeneration. Isolated trees and seedlings are most likely to escape infestation. The moths involved are species whose males fly in early winter and mate with wingless or near-wingless females, as they climb the trunks of the trees and eventually lay their eggs around the perennating buds. In severe infestations, eggs may actually be laid directly on the buds of seedling and saplings. In early spring, before the buds break, geometer caterpillars (probably the light emerald moth) have been observed to consume the leaf primordia within the bud scales and to ringbark leading shoots, especially if these were supplementary shoots of the previous year. Both types of damage result in partial dieback of the affected shoot.

7. Gall wasp damage.

Seedlings and saplings, especially if growth checked or in tubes, are particularly liable to be attacked by the currant gall wasp, *Neuroterus quercusbaccarum* The clusters of green and pink galls may entirely replace leaves in May and June, and this can be repeated on the same plants in successive years, thus causing complete growth check. Parthenogenic females of the same species are responsible for the common spangle galls on leaves of older trees.

8. Mouse and vole damage

High mouse and vole populations have not been found to have a serious effect on seedling numbers at Ardentallen even in poor seed years, since, although many acorns are certainly eaten, a sufficient number seem to be carried off and cached entire. In fact, the burial of acorns by wood mice may be important in securing germination, since acorns lying about on the surface are liable to dry out irreversibly in a dry winter and to be eaten by wood pigeons, pheasants and even sheep. Although the wet west Highland winter may not prevent germination while the acorn lies exposed, instability prevents the penetration of the radicle. The role of mice here seems to be contrary to the findings made in southern English oak-woods between the two World Wars. Scarifying the ground before acorn fall, or deliberate sowing, was found to be a waste of time, since this did not alter the proportion of acorns eaten and planted by mice. For several years in succession, badgers ripped up the turf close to the woodland edge in several places each

October in their search for earthworms along mole tunnels. Acorns were scattered in this natural scarification, but results were the same as for artificial disturbance and were not significantly different from broadcast sowing without scarification. Such a result throws doubt on the near folk-myth of wild and domestic pigs assisting oak regeneration in the woods. It is not known if bank and short-tailed voles cache the acorns in this way, but they certainly consume large numbers of acorns and damage germinated seeds at all stages of growth. Tap roots of established saplings can also be severed by voles.

Causes of failure once the oak saplings are beyond sheep reach have sometimes been bizarre. Ants have been found to kill the roots by building nests inside the tubes. Voles may nibble through the base of the stem even at this advanced stage of growth. Gale force winds can still snap saplings above the stakes, or after they have been unstaked, due to the forced growth resulting in tubes. Oak mildew (*Microsphaerium* or *Oidium quercinum*) can infect saplings, particularly lammas shoots, as it does the mature tree canopy. It does little lasting damage but may retard growth to some extent. Spring drought may result in sudden die-back of tubed or recently untubed saplings of both oak and hazel up to 1.5 m in height, especially on shallow soils, and it can take place before or after the buds break. Growth may be resumed later in the season, as stool shoots from ground level. This probably results from the forced growth of the shoots in tubes without adequate root extension.

Roe deer can be a problem at this stage in some woodlands but there has been little trouble so far at Ardentallen. The resident roe deer (usually buck, doe and kid or yearling) pass through the fenced area several times in most years, when they usually browse the low branches of ash, but sometimes those of oak and occasionally young oak saplings and hazel stool shoots as well. The bucks have caused some fraying damage to untubed trees, if these have not been wrapped in plastic or staked on two sides, but the leading shoots have rarely been touched.

Results

By 1994 some 1,500 trees, from seedlings to 3.0 m saplings, had either been established by planting or sowing, or had been 'rescued' as just described. About 500 of these - mainly oak and hazel - are now reasonably safe from further animal damage, and both nuts and acorns have been produced in small numbers over the last year or two (but see page 86). A few rowan, bird cherry, gean and guelder rose have also reached the flowering and fruiting stage. At the same time, three of the four surviving plots have produced birch thickets up to 4.0 m tall. Plot 4 also contains a number of hazel and rowan saplings now out of sheep range, as well as

several oaks which are still vulnerable. [This plot was destroyed by fire in March 1966; see page 86]. Only in Plot 2 have a few oaks succeeded in growing above the browse line within the eight years, although a greater number are still at risk. Plot 5 has many birches up to 3.0 m tall, but the understory of *Salix aurita* continues to be cut back savagely each time sheep break in. It has, therefore, been confirmed that oak woodland can be rejuvenated to some extent without excluding grazing sheep, given the cooperation and goodwill of the owner and grazier.

Cattle would require the longer tubing and heavier staking used for deer, although this does not look like being successful in the long term on areas where it is being attempted. Staking and netting of individual trees or small groups would probably be more satisfactory, but would be even more labour intensive than the methods described above. If the difficulty of specialisation in estate labour could be avoided, it is interesting to speculate that one individual could manage a small flock of sheep as well as an area of woodland of the size being restocked at Ardentallen.

No attempt was made to quantify the losses due to sheep damage in the course of the work, but after seedling rescue was abandoned in the summer of 1994 a count was begun of losses due to both sheep and human damage, at all stages up to staked trees over 1.5 m tall. Approximately 140 were completely destroyed, and a further 20 were damaged but retubed by the end of the 1995 season (see also page 86).

It has been found much easier to extend woodland along its margins, especially into scrub or broken rocky ground or thin bracken, than into closely grazed grassland or small clearings within the wood. The smallest size of clearing at various canopy heights in which oak seedlings will survive, at least to the tall sapling stage, has still to be determined. There is some evidence that this will turn out to be around the average diameter of mature pioneer oak crowns or the size of clearing that a well-grown tree leaves on being windblown in woodland, i.e. around 15 m. However, oaks have been successfully grown in tubes, to a height of 2.0 m, in clearings much smaller than this (c. 5.0 m in diameter) where canopy height has been less than 5.0 m. It is more practical to think in these terms, rather than in terms of light intensity, however measured.

Much also depends on the vegetation of the woodland floor and on the orientation of the clearings. The grass-dominated floor of so many of our woodlands, produced by centuries of grazing, is particularly inimical to successful oakwood regeneration. The whole process of obtaining this regeneration, or of rejuvenating a woodland by any means other than establishing a new plantation, is still more of a craft than a science and has not often been attempted.

SUCCESS AND FAILURE IN OAK REGENERATION

Sequence of Events

What is the probable fate of a newly fallen acorn, assuming that it remains uneaten? The most likely sequences of events can be summarised as follows:

1. It remains on the surface and dries out to below the moisture level for continued viability. This is unlikely in the west Highland climate, but it can happen.

2. It lies all winter on the surface, lightly covered with leaf litter and debris, and produces a short radicle which fails to penetrate the ground. It then dries out in spring and germination is not completed.

3. It falls into a slight pocket or crevice and is covered sufficiently by debris over the winter to allow the radicle to obtain a grip on the soil. Germination proceeds normally in spring although the acorn is lying virtually on the surface. This is not the usual course of events, but is common enough in a damp climate.

4. The acorn is carried a short distance by a mouse or vole and is buried uneaten. Germination is normal, and most seedlings result from this course of events.

4a. The germination site is short, grazed grassland, or a blaeberry and moss woodland floor. The first year seedling, which as a rule has 2-4 leaves and attains 5-10 cm in height, then grows by only a few mm per year, with the stem becoming decumbent and moss-covered as it does so. The apparent height of the seedling seems to remain unchanged. If unbrowsed it can persist for ten years or (much) longer with little change in appearance. If browsed in its first year a new shoot is produced in the second year, which can be mistaken for new germination unless carefully examined. This can be repeated for two or three years or more before the seedling dies. There is thus an annual seedling replacement over the years, provided that acorns are being produced, but regeneration is really static and superficial observation results in optimism which is completely unfounded. Should the canopy be opened by clear felling or natural disaster, it may only be the physiologically younger seedlings which respond to the increase in light intensity. Experiments carried out to test this conjecture have been inconclusive. If there has been no seedling recruitment for several years, an apparent abundance of advance growth would then fail to respond to canopy opening. Under a complete or almost complete tree canopy a better lighted seedling

may produce supplementary growth of the leading shoot during a warm summer, but this does not alter the overall picture. Under these circumstances the presence or absence of browsing animals is largely irrelevant.

4b. The germination site is short, grazed grassland in the open. The seedling is soon eaten deliberately or inadvertently but may persist in stunted form for several years.

4c. The germination site is ungrazed grassland in the open. The seedling is usually smothered within two or three years, since it cannot outgrow the grasses and tends to be pushed flat by the dead grass mat in winter.

4d. The germination site is in tall bracken or a bracken and grass mixture. The seedling has little chance in the dense shade even with a southerly exposure.

4e. The germination site is a lightly grazed or ungrazed dwarf shrub community, usually a heather and blaeberry mixture with some sedges, grasses and mosses. The seedling has a sporting chance here, since it can keep pace with or even outgrow the dominants, provided the soil is not too infertile. Such vegetation is not generally as heavily stocked as pure grassland, and the oak can tolerate occasional browsing damage.

The natural regeneration sites of oak which are most often seen at the present day are thus linear ones with open vegetation, such as occur along roadsides and railway lines or on steep rocky slopes on a woodland edge.

A natural oak seedling making optimum growth has been shown to require freedom from domestic animals for at least six or seven years. Planted nursery stock might survive with a year or two less, but in the presence of red or roe deer these would require many more years in order to bring their leading shoots above the browse line. Birch, ash, hazel and rowan can all survive with a shorter browse-free period; the Ardentallen experiments have indicated around ten years for oak and six years for the other species.

The overall difficulty experienced by oak in regenerating successfully at the present day, combined with its known late penetration of the west Highland region, makes it seem possible that it could not have formed dominant woodland here - even during a more favourable climatic phase - unless the Neolithic pastoralists had actively encouraged it by herding their stock away from likely patches of young growth. Although habitation and animal folding may well have been in the shelter of mature woodland, the main grazing areas and patches of cultivation would have been separate from these on flatter and more fertile ground. It may, of course,

have been that oak benefited from any protection accorded to hazel as an important source of wild food.

Oak and Ash Regeneration Compared

The way in which ash manages to regenerate, under an intensity of sheep grazing which completely blocks establishment of oak, is impressive and calls for an explanation. Ardentallen has been a good place to study this since there has been a small but regular accession of young ash trees over this century at least, although oak has signally failed (Figures 16 and 17). Careful observation over the years while working with both species has supplied a number of hypotheses, although perhaps not the final answer.

The principal factor at work appears to be the strongly excurrent growth of young ash combined with a faster rate of growth. By way of contrast, few young oaks develop a strong leading shoot, even in tubes; they tend to branch and spread out widely, thus rendering themselves completely vulnerable to browsing animals for an extended period. After damage, ash quickly forms a new leading shoot from the available buds and continues to gain height rapidly, while oak merely produces more spreading laterals. Even while protected in tubes, most young oaks are inclined to branch into a number of thin shoots with consequent loss of vigour and delayed emergence.

The second important factor is the greater shade tolerance of the ash. This enables it to take advantage of any protection against animals, such as rocks and thorn scrub or the intermingling of low branches and bracken, most of which produce sufficient shade to put oak seedlings at a disadvantage. Added to these factors is the ability of ash to set seed prolifically in most years, to retain viability for a long period in the soil, and to be attractive to foraging earthworms which draw the winged seeds down into the soil during the hours of darkness.

These factors taken together may account sufficiently for the common sight of ash poles - often in large groups - threading their way upwards through the branches of hazel or mixed scrub. Steep stony slopes and woodland margins, especially with low sweeping branches, or dense whin and blackthorn thickets, are all localities where ash saplings are likely to be found. Being wind borne, the seeds of ash are also capable of more widespread dissemination than those of oak, which are seldom found more than a few metres from the canopy edge of the parent tree. It takes a heavy rate of stocking to inhibit ash regeneration completely where there is a good seed supply and the terrain is rough - but this stage has now been reached at Ardentallen and ash recruitment appears to have stopped within the last decade

Figure 16

Patch of ash regeneration on scree slope carrying older hazel scrub with emergent oak and ash. Probably an even-aged group c. 35 years old. Note absence of young hazel and oak.

Figure 17

Rear of 'sanatorium' amphitheatre, showing mature oak-ash woodland with hazel understory and young ash of all ages along the woodland margin on scree.

or two. On the other hand, young ash is slower to begin flowering and fruiting than the oak.

It is difficult to avoid the general conclusion that oak is ill-adapted to the present climate and land use of the west Highlands, in comparison to the ash, and that, wherever soils are suitable, oak woodland will inevitably be replaced by ash woodland in the long run and in the natural course of events. Ash, too, being liable to canker, provides a greater number of holes and hollow stems than oak, and is thus more favourable to many species of wildlife. While the large food store in its cotyledons, and the ability of the embryo to produce axillary shoots as well as the plumule, confer an initial advantage should there be early damage to the seedling, the former also renders oak fatally attractive to a wide variety of animals, from mice and voles to wood pigeons. Unless accidental distribution by rooks or pigeons occurs, practically all seeds fall within the spread of the canopy or 1.0-3.0 m outside this. Mice do not carry the acorns far before eating or caching them, such as they often do with the hard-shelled hazel nut. This ensures that most seedlings begin life in less than optimal light intensity. The northern climatic limit of both species of oak lies somewhere across the north of Scotland, and it can safely be assumed that the limiting factor in distribution is the same as it is with most trees of temperate climates - a lack of summer warmth, generally expressed as a deficiency of accumulated day-degrees. As already pointed out, the oak seedling certainly shows a striking sensitivity to the incidence of direct sunlight in a climate where air temperatures are often low during the growing season. Older oaks, from 2.0 m saplings to mature trees, are tough customers, but, were they sentient beings, it would be excusable to say that the younger stages sometimes appear to lack the will to live. Comparison with young ash, which lacks several of the oak's advantages, is again particularly striking.

OTHER WOODLAND TOPICS

Note on Lammas Shoots

The so-called lammas shoots of oak are of two kinds; supplementary determinate growth which may take place once or twice in the season following initial elongation from the winter bud, and the true lammas growth which is indeterminate and may be of considerable length since it is capable of continuing until terminated by the first frost. Determinate growth which ends early in the season generally forms an obvious bud, or at least a resting shoot tip, if a second flush of determinate growth is to follow, but indeterminate growth does not form a resting tip of any kind, so that considerable winter die-back may ensue and the imperfectly ripened issue is more liable to fungal and insect attack. The next season's growth is then carried on from an axillary bud lying some distance back

from the tip. As the seedling ages, its ability to produce indeterminate as well as determinate supplementary growth increases, and strong saplings six or seven years old can produce shoots up to one metre in length, although these may be neither vertical nor straight. As a rule, such phenomenal growth is not repeated in successive years by the same sapling. In partial shade, seedlings take much longer before they are capable of forming even one length of supplementary determinate growth. Winter die-back of determinate shoots with true resting buds can also take place, especially in a hard winter. True lammas shoots are particularly liable to attack by oak mildew, both on saplings and on mature trees.

Wind-thrown Trees

Twenty or thirty large oaks with pioneer crowns were uprooted or snapped in two severe storms from the west during 1988-89. This appears to have been one of the most destructive episodes of the present century and perhaps of the last two. Further storms in January 1993 felled many moribund ash and large mature birch trees, and snapped portions off the crowns of further oaks.

Four or five other noteworthy storms are recorded as affecting the west coast of Scotland, and sometimes wider areas, since late last century: those of December 1879, November 1912, January 1953 and January 1968. There was also the storm, coinciding with an exceptionally high tide, which flooded and put an end to the Easdale slate workings in 1881. Another storm blew from the north in 1893. Prostrate trees dating from the 1968 storm have been easily identified, since they were noted in 1970 just as the new upright shoots were beginning to grow from the prostrate trunks. These shoots are now substantial stems at 25 years of age. The 1953 group is less easily identified and few trees may have fallen then. The older groups have to be lumped together, as there is no way of making ring counts and stems between 80 and 113 years of age cannot be distinguished on diameter alone (Figure 18). Surprisingly, few fallen trees die completely and these are virtually impossible to age. Considerable numbers of such ancient and prostrate dead trees lie in the woodland. They now consist of heartwood only and could have fallen at any time over a century ago. The time intervals between exceptionally stormy periods do appear to be decreasing, although nothing is known of the comparative severity at this location of the various storms known only from the historical records.

Oaks do not fall unless windthrown; they die on their roots and persist as dead snags for many years. Ash roots, on the other hand, rot readily right up to the bole, so that moribund or dead trees will fall even in the absence of wind, especially during periods of high soil moisture. Dead stumps of felled oaks which have not coppiced, or of dead coppice shoots, also persist for many years, the roots rotting

Figure 18

A wind-thrown oak, perhaps marking the storm of 1912. The top has been sawn off, and shoots from the bole have produced new stems. Note that the original shoots must have been well within reach of cattle and sheep.

gradually to leave loose stumps which can then be pulled easily from the ground. Many of these can be found standing or lying around on the surface in the woodland, and have not changed in appearance over two decades so that they must be of great age.

Most large trees fall downhill, or at an acute angle to the slope and, after they have rotted away, the straight or curved bank can be made out, sometimes with an associated pit and downhill hump or stone heap. Such marks on a slope are usually unmistakable, and are frequent in the woodland although less numerous on the slopes above. Since it must take many centuries for fallen mature oak to disappear as completely as this, the marks also attest the antiquity of the woodland and the probability of scattered large trees outside the present wood at an earlier date. The map of 1871 indicates much the same distribution of woodland as at present.

Timber Felling and Charcoal Burning

According to Lindsay (1975), a "supplementary contract" for a single clear felling was entered into between the Lorn Furnace Company and Ardentallen Estate in 1793 (Rennie, 1992). If this had been carried out the effects would have been patently obvious today. However, the low percentage of oak stems of coppice origin in the woods, and the paucity of charcoal stances (all of which are on recessed platforms), indicates that the contract was never carried out or that it concerned only the partial felling of the wood for structural timber, with charcoal making confined to the lop and top. The few patches of hazel which have been coppiced must have been cut more recently than this for other purposes, and all are distant from the stances. An interpretation of the woodland structure has already been given, as having resulted from a regime of timber utilisation of long standing, with use of scrap wood for charcoal production in later years. Perhaps some of the timber fellers' hut sites were then used as charcoal stances. Three of the recessed platforms have never been used for later charcoal production, and no unrecessed stances have come to light. It is impossible to say whether sufficient timber felling ever took place at any one time to make the export of tan bark another likely source of revenue.

OAK MEETS PINE

This may seem rather a strange ecological issue to have investigated at Ardentallen. It was originally undertaken because the area offered facilities for the continuation of experiments carried out elsewhere in former years, but it does have some relevance here in an historical context.

As a result of recent investigations by palynologists and peat stratigraphers, it is now realised that pine has an extremely complex and somewhat surprising history in Scotland, compared to the simple story of its invasion of southern Britain from Europe with its later replacement by mixed oak forest. It would appear that oak arrived in Argyll from the south before pine appeared from the north, between 5,000 and 6,000 years ago, and that the two forest types met along more or less the line where they now stand. Without the still earlier appearance of mankind in this debateable land, oak and pine might by now have intermingled at least as far south as mid-Argyll. In essence, the pine invaded from the north upon the raw ground moraines of the Loch Lomond stadial, while oak was able to occupy the already mature glacial till of the previous (Perth) stadial in competition with existing birch-hazel woodland. This is simply a local variant of the world-wide phenomenon of competition between coniferous and broadleaved forest, which is far from completely understood.

Seedling Stage

One approach to the problem is to investigate how competition between pine and our deciduous broadleaves operates at the seedling stage, when the various species are attempting to colonise the available mixture of peats, mor humus soils and acid to neutral brown earths, each with its appropriate herbaceous and shrub vegetation. The necessary range of soils, vegetation and animal exclusion plots was already available at Ardentallen to enable a number of simple experiments to be carried out. These will not be described in detail, and results are probably not statistically valid, but a number of hypotheses can be constructed and are available for more rigorous testing. The behaviour of pine seedlings on various peat types and mor humus soils was already well known, so that it simply remained to investigate germination and early establishment on the brown mineral soils and vegetation types available.

Pine seeds will germinate, but the seedlings will not survive for more than a year or two at most, on the unbroken vegetation of fertile brown soils. They are taken by cutworms and other herbivorous invertebrates at the cotyledon stage, and they are quickly outgrown and shaded out by grasses and other herbs already in possession. On one occasion, etiolated pine seedlings in a grass turf were finished off by a sharp ground frost - and pine is remarkably frost-hardy at all stages of normal growth. Possible niches for pine invasion at Ardentallen are made by mole hills, rabbit scrapes and the root plates of fallen trees. These places are at least temporarily low in soil invertebrates, but the seedlings, which survive browsing by rabbits and voles on the two former sites, are eventually shaded out as the vegetation closes in upon them. An even more striking effect can be obtained by

local treatment of the turf with a soil pesticide such as Bromophos, but the final result is the same if the seedlings can be outgrown by the original vegetation. Only on the substantial root plates of windthrown trees, and on the disturbed soils which windthrows create, has it been possible for the pines to survive and it remains to be seen if these will attain reproductive age - when it may be said that the 'invasion' has been successful. But root plates are droughty places and all tree seedlings, including oak, suffer desiccation there from time to time. Mortality has been the same for both oak and pine on these sites so far. A few young pines have also survived on pesticide-treated plots in thin, heathy vegetation of open oak-birchwood. Results are dramatically different on infertile peaty soils, where there are relatively few invertebrates and where the natural vegetation, such as heather, is unable to outgrow the seedlings. At five years of age there are eight young pines or small groups within the oak-birch woodland and on isolated oak root plates elsewhere. The largest plants are 45 cm tall and should manage to continue growth for many years barring accidents. Many broadleaved trees, including oak, are also able to invade infertile acid soils, but their growth rate is reduced while that of pine is not -until infertility becomes extreme. In such sites, then, competition operates at a later stage of growth. In summary, biologically active soils favour broadleaf invasion and consolidation, while infertility favours the pine.

Mature Stage

An experiment on the later competition between broadleaves and pines on the same soil was inadvertently carried out in the garden at Ardentallen. Although the pines grew exceptionally well, they were still outgrown by birch and alder. The well-known effect of pine leading shoots being 'whipped out' by birch was obtained. This results from the fact that conifers have fewer buds and growing points ready to take over on the loss of the main shoots. Evolutionarily more advanced broadleaved species have a greater reserve of dormant buds of all kinds. The ability of the evergreen pine to carry out photosynthesis during the dormant season of the broadleaves does not save it from the severe handicap of being outshaded during the summer growing season. If the early stages of growth are bypassed by planting out nursery pine and oak stock on soil of average fertility, the two can live reasonably well together for an indefinite period. The pine can outgrow the oak, even on fertile soils, but is the poorer shade bearer and the less resilient following shoot damage or other disaster. The oak dominates the situation in subsequent generations, just as the pine will tend to do on raw humus soils.

Within a high rainfall region of the 'oak zone', bare rock outcrops of low relief quickly accumulate moss, lichen growth and wind-blown plant debris, which within

a matter of a few decades can become colonised by heather, blaeberry and *Erica cinerea,* amongst other things. Raw humus soon develops, which can form a suitable substratum for colonisation by pine and juniper as well as seedlings of hazel, birch and rowan, but not generally oak. The first trees do not attain great size before they are windthrown, but this provides even better niches for a second generation of tree seedlings which may gain a stronger hold and so survive to greater size. In this way, a mosaic of oak and pine dominant woodland or forest can develop on broken glaciated topography, even where the country rock and soil base status are generally high.

THE HILL LAND

Bracken and its Control

All over the west Highlands there is probably a greater area under bracken today than there has ever been; so is there at Ardentallen. In the days of the runrig cultivators, bracken would have been a sparsely distributed and mainly woodland species valued, along with other large ferns, for animal bedding. Harder winter frosts in those days may also have checked the growth of the rhizomes. Although late spring and early autumn frosts kill the fronds, they do no lasting harm to the plants, which are well supplied with resting buds, but 4.0° C of frost in the soil at rhizome level, even for a few nights, will do considerable damage. This seldom happens now, even on shallow soils.

Bracken would have started to advance here after the two Ardentallen farms were demarcated in the 18th century and the old hill cultivation was replaced by grassland. It was probably still held in check to some extent by cattle trampling, continued cutting for bedding, and probably colder winters than today. Its last, rampant, phase has been marked by the end of farming and the final replacement of cattle by sheep on the ground. The continuation or introduction of moor burning, with the liming and slagging of the hill which was carried out at the very end of the farming era, must have helped the bracken on its way. There has also been a marked increase in the succession of milder winters without penetrating frost. The progressive formation of a mat of dead fronds to a depth of 20-30 cm in places also helps to insulate the underlying rhizomes.

The options available for bracken control today are: cultivation and reseeding; conifer plantation; systematic cutting by hand or machine; and asulox spraying from the ground or from the air. The first two can often be ruled out for one reason or another; the second two have been tried at Ardentallen. In 1984 helicopter spraying was carried out over most of the hill land, with attempts to

include bracken-filled woodland clearings. It was almost a complete failure, probably because of the broken nature of the ground and the difficulty of achieving an even application. Small patches in which satisfactory control was later observed also tended to suffer grass kill (particularly of *Holcus*) and this points to a local overdose with concomitant under-application elsewhere.

In 1986 intensive hand-cutting was commenced on limited areas, and these were extended over the next five years or so with satisfactory results. A strimmer was employed to begin with when working close to base, but hand tools were found to be more versatile on steep slopes and among rocks and dead branches. Cutting was abandoned wherever weeds such as foxglove and thistle tended to benefit rather than the grasses, and areas with tussock *Deschampsia* and rushes were avoided altogether as it is difficult to make a clean cut there. It was found that small and isolated areas of bracken could be completely eliminated within three years or so with three or more cuttings per year as necessary, and four such areas, amounting to some 500 m^2, have been successfully dealt with. Larger areas were simply reduced to an acceptable level of infestation and cutting was then discontinued, as it becomes unrewarding to attempt complete elimination on too large an area by hand. In any case, a moderate bracken cover protects the summer growth of grass to some extent, to leave standing hay (of low nutrient value, admittedly) for the sheep to forage for in autumn and winter. These tactics can only apply when summer grass is in surplus, as it is on much hill ground. Control was never attempted where a thick thatch of dead fronds had built up over the years and eliminated most other plant growth. This is what happens when a tall lush growth of bracken subsides in the same direction each year, under the influence of wind and rain from the south-west in early to mid-July. Sheep are reluctant to enter these areas of aligned fronds, so the litter is never broken up and dispersed as it is where the bracken withers standing or falls in clumps in different directions. A thick thatch of bracken, especially on steep slopes, can render large areas of hill ground permanently closed and unproductive. Sheep will make a few tracks through the dead bracken to get from one area to another, but will otherwise ignore it. If areas of this kind are systematically sprayed, burned or cut, then foxgloves, rushes, whins and *Deschampsia* tussock quickly take over and may persist until bracken recolonises before the bent-fescue grasses do. This has been done at Ardentallen, but only to clear archaeological sites or prepare a small plot as a forest nursery. It can, of course, be a useful preliminary to reseeding, with little further surface treatment required beyond the raking aside of bracken litter.

It has occasionally been pointed out (Darling, 1955; McVean and Lockie, 1969) that one virtue of bracken infestation appears to be that no soil deterioration in either the physical or chemical sense can take place once the bracken plant is left in

control. Further exploitation by overgrazing is certainly prevented, but the hypothesis has never been tested. It might be supposed, for example, that the virtual absence of grazing from areas of complete bracken dominance halts further removal of minerals, such as calcium and phosphorus, in the exported animal carcases. On the other hand, there is also a cessation of nitrogen recycling in the absence of grazing and dunging, and it could be reasoned that a certain amount of fertility will tend to be concentrated in the reduced areas of grassland on which the stock are now confined - at least so far as nitrogen is concerned. Attempts to compare the fertility of the top-soil on adjacent areas of long-established bracken and uninfested grassland at Ardentallen, by means of a primitive bio-assay using potted brassicas, has given inconclusive results. On the other hand, it has been observed that the larger, casting species of earthworm tend to be scarce in areas of long-established bracken dominance, and this is reflected in the total absence of molehills. Where moles are abundant close by, it has been observed that bracken clearance followed by the re-establishment of a grass turf has resulted in mole colonisation of the cleared area within three years. Further studies are required.

In general, bracken control and tree planting should be kept apart on unfenced ground, since locally improved grazing is very attractive to the sheep which then congregate around the tubes and cause damage by rubbing or lying against them. Lambs will deliberately push over the smaller tubes in the course of their play in the first month or two of life.

Where stretches of good pasture alternate with steeper slopes, completely bracken-dominated and impossible to improve by mechanical means, tubed planting in the bracken areas can be carried out more economically than by the fencing of many small plots, with the disproportionate lengths of fencing this entails. Bracken control around the young trees is required in both systems. Where the local rock consists of Devonian or Tertiary lava flows, this is the type of grass and bracken distribution most often found, and there may also be dense whin thickets accompanying the bracken on the steep slopes, where there could more usefully and naturally be ash-hazel stands or mixed woodland.

Sheep and Soil Erosion

The various forms of accelerated erosion of mineral soils for which sheep are responsible can all be seen at Ardentallen. The most significant results in permanently bare soil, and its local displacement, where there should be a woodland floor; this rather than a complete removal of soil by surface run-off. For such a situation to develop, the woodland must be on a steep slope and must have passed through a dense thicket stage, giving shade sufficient to kill off the majority

of herbaceous species present, including grasses. In the absence of grazing animals, the soil becomes recolonised by shade-bearing woodland plants and progressively more light-demanding species as the thicket opens out by self-thinning. Where sheep are present in the usual numbers, the slopes are maintained in a state of permanent instability due to the passage to and fro of the foraging animals. The end product may be completely unvegetated scree, or a bare soil slope which is liable to rain splash erosion even in only moderately heavy rain. In total, there must be several acres of such ground, mainly in hazel scrub and mixed hazel-ash woodland, at Ardentallen. The largest single area lies on the south side of Ardentallen Point. The ground may appear reasonably well vegetated in its vernal aspect, but the bluebells, lesser celandine, earthnut and other spring flowers provide cover for a short time only, even if ungrazed.

The remaining types are of less significance and are as follows:

- Sheep scrapes on steep slopes, resembling golf bunkers. These can have been developed originally from windthrow of trees, rabbit burrows or any other source of disturbance. They do not grow indefinitely, whatever the rainfall, but become seriously confluent on soft basaltic soils.

- Sheep tracks on steep slopes where topography or local obstacles limit the directions an animal can take. Damage is usually slight unless there is channelling of run-off during sudden storms, when there may be local scouring and gullying with deposition of soil and stones on the vegetation immediately below. In continental climates with marked wet and dry seasons this can develop to give much local damage. Incipient scouring and deposition has been noted on several occasions following heavy rain, even in an oceanic climate such as that at Ardentallen.

- Formation of incised drainage channels from small bogs, due to heavy grazing and trampling during a mild wet winter when fresh growth of the vegetation attracts sheep to these areas. If a period of heavy rainfall then follows, the damaged water-spreading system of the bog surface cannot cope with the run-off and a channel is cut towards the steeper grassland below. If the grassland is overgrazed, these channels may extend and develop into deep gullies with vertical sides. There are good examples at Ardentallen, which are often regarded as completely natural. Minor gullying can also take place within the woodland, where seasonal streams enter an area bared of vegetation by shading and trampling as described above.

Sheep and Floristic Improverishment

In spite of what has been said in a previous section about sheep as destructive browsers of tree seedlings and low branches, they are generally regarded as selective grazers in contrast to the less discriminating cattle beast. This is true, except that it must be remembered that they tend to select tree browse in preference to course grasses. Certain breeds, such as the Scottish Blackface and the Swaledale, seem to incorporate some of the less desirable features of goats in their consitution. They will climb trees to get at the epiphytes such as *Polypodium* fern, if the tree leans sufficiently or forks conveniently near ground level, and they will climb apparently inaccessible cliffs to tear the ivy off the rocks. More devastating still is their foraging activity in early spring, when none of the less common species which makes an early appearance, and is not actually distasteful, can count on long survival. The fact that sheep are often close to starvation at this time reflects on the management rather than the breed. There are some small offshore islands in Argyll which carry a few feral goats but no sheep, and an examination of their vegetation would lead the conservationist to prefer goats as far as herbaceous plants are concerned.

Feeding blocks of high carbohydrate supplement to sheep, to stimulate the ruminal flora and lead to a higher intake of rough forage, accentuates this tendency to browse on woody material. While it does seem to increase the intake of fibrous cellulose in the form of dead grass and any live material of low nutritive value, it also produces an almost depraved taste for the useless lignin of living and dead wood and leads to even more severe bark-stripping, the gnawing of dead branches and surface roots of the ash and further damage to tree seedlings and saplings.

The following lists have been compiled as a result of over twenty years' observations at Ardentallen and more widely throughout Argyll:

1. **Species known to have been considerably reduced at Ardentallen over the last two decades.**

Sanicula europea	*Arabis hirsuta*
Rubus saxatilis	*Hypericum androsaemum*
Allium ursinum	*Dactylorhiza fuchsii*
Orchis mascula	*D. purpurella*
Allium vineale	*Selaginella selaginoides*
Jasione montana	*Geranium dissectum*

It has been easy to follow the decline of *Orchis mascula* over the years, since it is a conspicuous species of spring and early summer. It is generally the flowering spike alone that is eaten, or simply chopped off and left lying. Once widely distributed throughout the woodland and in a number of grassy places irrigated with lime-rich water, it is now largely confined to the far north-western end of the wood where the ground is steep, wet and craggy.

In the spring of 1994 a small colony of *O. mascula* appeared during the interval of a week or two when most of the sheep had been removed elsewhere for lambing, and on a site where none had been known in former years. This was on the caked and bare soil of eroded ash-hazel woodland (page 77) above Sailean Ruadh. Within one week of the sheep returning to the ground, all plants had been completely eaten, the numbers being reduced in the following sequence from day to day: 14, 12, 7, 5, 2, 0. This happened even although there was abundant grazing in the immediate vicinity. It is quite likely that this colony will now disappear for another extended period, and leads one to speculate about the extent to which orchids spend much of their total existence underground in the presence of too many grazing animals.

2. **Species known to have been reduced to one or two plants only.**

*Menyanthes trifoliata**	*Agropyron caninum*
*Dactylorchis incarnata**	*Cephalanthera longifolia*
*Anthyllis vulneraria**	*Daucus carota*
*Gymnadenia conopsea**	*Rosa pimpinellifolia*
	Lythrum salicaria

* Successfully, but alas only temporarily, rescued from the brink.

3. **Probably comparatively recent colonists whose spread has been checked by increased sheep stocking.**

Sparganium erectum
Botrychium lunaria
Antennaria dioica (unsuccessful attempt at rescue)

Chamaenerion angustifolium } One of the few benefits
Acer pseudoplatanus } of sheep!

4. **Species recorded from the local 10 km grid square, or adjacent squares, which could have been lost to Ardentallen recently.**

Hypericum elodes	*Anagallis tenella*
Juniperus communis	*Trollius europeus*
Helianthmum chamaecistus	*Montia fontana*
Prunus avium	*Prunus padus*
Epilobium hirsutum	*Epilobium roseum*
E. obscurum	*E. palustre*
Carum verticillatum	*Empetrum nigrum*
Melampyrum pratense	*Odontites verna*
Pinguicula lusitanica	*Campanula rotundifolia*
Cirsium heterophyllum	*Listera cordata*
Listera ovata	*Leucorchis albida*
Platanthera chlorantha	*Glyceria declinata*
Millium effusum	*Schoenus nigricans*
Carex distans	*Carex vesicaria*
C. otrubae	*C. remota*

List 4 is conjectural, and includes species recorded from adjacent grid squares which have suitable habitats on Ardentallen and which could have been adversely affected by the management of the last few decades. The species of List 2 would have been placed here had they not been discovered in the course of the present study. Species may yet be transferred from List 4 to List 2. Unlikely species, such as *Ophioglossum vulgatum,* have turned up although they would not have been included in List 4.

So far as is known, this is the first time that progressive species impoverishment caused by present-day stock ranching has been followed in this way, at least in Argyll. It makes it easier to understand how species now come to be reduced to tiny colonies on inaccessible crags or in spots of lime-rich marshland. Each 'good' locality has a different selection of species, so that many rescue bids have to be made to arrrest the decline significantly. It has long been recognised that fragmentation of the range of any species in this way hastens its progress to eventual regional or national extinction.

A comparison of cattle/sheep ratios in the various localities is also instructive, as it has been observed that the higher this figure, the more likely is the survival of the calcicoles. On Ardentallen, it has been possible to follow in detail the deleterious effects of a sudden decrease in the ratio on the representation of these species, over a matter of two decades.

Moor Burning

It is impossible to say when systematic moor burning would have been introduced at Ardentallen; probably not during the runrig days and possibly not until late last century. Burning of dead grass and live whins continues to be carried out at the present day in a haphazard and opportunistic way, more as an article of some vague faith in its efficacy than as a well-understood management tool. There is no heather left to burn, although depauperate shoots, browsed to the quick, occur on most of the raw humus soils, where they are now dominated by *Molinia, Nardus, Juncus squarrosus* and other plants. Fires are set in the 'white grass' during a dry spell in spring and are allowed to burn more or less where they will, through whin thickets and dead bracken thatch into the leaf litter of the woodland edge.

There is strong circumstantial evidence that the abundance of whin here, as in many other parts of the Highlands, at the present day has resulted from past moor burning, especially on the thin soils around rock outcrops. It has been shown experimentally at Ardentallen that whin seedlings appear wherever soil is laid bare for a season or two close to a source of seed. This can occur after fires and after the clearance of a dead bracken thatch. Where an area has carried whin for a number of years the soil seed bank becomes well supplied with the seeds, which have many years of viability. Strangely enough, considering the readiness with which it is browsed, sheep seen unable to prevent whin colonisation on this type of ground. Leading shoots are topped, but the rest of the plant is left to sprout again and so it gradually draws ahead until above the browse line. This appears to have something to do with the length and orientation of the spines on the young plants. The sheep prefer the outer shoots of the old bushes, especially those with flowers or flower buds, and break them off from underneath. Of course, seedlings which appear in open grazing are eaten inadvertently at an early stage along with other plants.

It is generally accepted that moor burning where there is bracken infestation merely hastens the spread of the bracken. All too often, dense infestations of bracken and whin occur together and for much the same reason. Burning of mature whin thickets can merely rejuvenate them, while the older stools, which burn less readily, do not always recover as readily from cutting. Grubbing out the stools prepares a seed-bed for another crop. Elimination is best achieved by allowing the bushes to die naturally while avoiding any soil disturbance in the vicinity. This is not easy, since sheep lie in the shelter of the bushes as long as shelter exists and their repeated browsing and trampling lays bare the soil. If

cutting is carried out as close to ground level as possible, there is usually a dense regrowth of soft shoots which are readily eaten by stock and are highly nutritious.

EPILOGUE 1995-1996

Sale of Lower Ardentallen

In the summer of 1994 the Lower Ardentallen ground was offered for sale on the open market. Prior to the appearance of the advertisement, the Craignish Conservation Trust obtained an agricultural valuation of the 280 acre property, allowing for the reasonable chance of planning permission being obtained for the erection of one dwelling house and taking into account the value of any woodland grants accruing. This valuation amounted to £40,000. Any 'conservation value' over and above this was known only to C.C.T., who nevertheless allowed a premium for it, in a private offer of £42,000. This was understandably rejected by the sellers and, on the advice of the agents, an asking price of £100,000 appeared in the lushly worded notice of sale. The advertisement made no pretence of 'development potential' but ignored the run-down and bracken-infested nature of the property. Instead, the agents made great play with the scenic delights and secluded situation within easy reach of the amenities of Oban. The property was quickly sold for a figure exceeding the price asked.

The C.C.T. maintained at every stage, and in all negotiations, that they would prefer not to have to purchase the ground, provided that land use more acceptable than in the past could be ensured. Nevertheless, an offer to purchase had to be made to meet every eventuality although, as it happened, it would not have been possible for the Trust to raise more than half the asking price, which was the absolute limit considered reasonable with respect to the agricultural productivity involved. Until settlement day at the end of June it still seemed possible that a satisfactory management agreement could eventually be concluded with the new owner, but immediately afterwards it quickly became apparent that this was a forlorn hope. The purchaser had undertaken, as a condition of sale, to honour the agreement concluded between C.C.T. and the owner in 1990 over the 1.5 ha fenced area, but the Trust was now left in no doubt that its other activities would be accepted only on sufferance from day to day and would be a perpetual source of irritation to the new owner as he put into effect his own intentions regarding the use of the land. In these circumstances, the Trust declined to undertake further attempts at woodland rejuvenation or preservation of remaining floristic diversity. In other words, the situation reverted to that existing in 1986 (with the exception of the fenced area) and all hope of a new era in which woodland and sheep management could proceed on a more equitable basis had to be abandoned. At the

time of writing, the full intentions of the new owner remain unknown although it is clear that the former *laissez faire* will be abandoned (and see page 87).

A further unkind cut lay in the fact that the sellers had reserved from the sale the small area around the water-filled quarry holes, and had applied for planning permission to erect one dwelling-house there. This placed in jeopardy the historic quarry site, listed in R.C.A.H.M.S., Argyll Volume 2 (Steer, 1975), as well as the features described in Appendix 4 and Appendix 5. The plans also showed an intention to route the water supply pipe through the heart of the woodland and across the C.C.T. fenced area. Objections were made to Argyll and Bute Planning Department on archaeological and environmental grounds, but it has since been learned that the authority has lived up to its reputation in such matters by granting permission for the development, although it still remains to be seen if any restriction will be placed upon the route of the water pipe or the destruction of the quarry holes and shell bed.

The Redundant Management Agreement

It might be of some interest to the reader to set out a brief outline of a management agreement which would have been suggested to the new owner had the opportunity been given.

Desiderata

1. Mechanical cutting of bracken, with grass below, on level or gently sloping ground, to improve grazing.

2. Fencing and tree planting, of dense bracken over deep litter with no grass, probably under grant scheme.

3. Fencing, at C.C.T. expense, of small floristically-rich spots in woodland and bog.

4. Tube rescue of volunteer tree seedlings on woodland edges and in broken ground, with bracken to continue as at present.

5. Moor burning to be discontinued. Whin cutting (not burning) in selected places.

6. Feeding of Rumavite blocks to be replaced with bought hay at C.C.T. expense. Possible attempts to make small amounts of own hay. Limited grazing deferment.

7. Repair fencing of Lower Ardentallen inbye grassland, and lime at least part of this.

8. Some stock reduction, at least until there is control of bracken, and lime application to grassland. The amount would depend on area of further fencing for trees.

Ideally, the area of the woodland to be fenced should be larger than the small 1.5 ha plot, with one block in the outer woodland and at least one more in the inner woods. Some or all of this might qualify for a woodland grant, especially in view of the large acorn crop in 1994.

Sufficient woodland to be left on all exposures for sheep shelter. Planting or regeneration grant areas to be chosen or approved by C.C.T. to avoid floristically rich spots in bog or open scrub.

Further plans for dealing with some of the whin scrub, and alternative fencing and grazing schemes, were also prepared but will not be elaborated here.

Much of the insight into woodland regeneration and management gained over the eight-year period cannot now be employed further, and the young trees successfully established will lack the context of multiple land use and therefore much of the significance originally envisaged for them, if indeed they survive at all (see page 86). It has been amply demonstrated over these years that constant vigilance and ingenuity can substitute to some extent for expenditure on materials and equipment, and that labour intensive methods can have a place, especially if the labour comes free. Furthermore, results are just as satisfactory, there is a greater chance of making useful discoveries, and a deeper understanding of the species ecology is gained in the end.

Finally, a quick glance at the financial side of the eight year interregnum. Over this period the sheep may be estimated to have grossed some £48,000 as fat/store lambs. Nothing has been returned to the land save animal dung and the carcases of casualties; management has been purely extractive. Furthermore, the ranching has been subsidised by the state in H.L.C.A. payments of some £19,000. Over the same period C.C.T. has added value to the property in the form of young oaks and other trees currently of various sizes (say £8,000 net) at a cost to charitable sources of some £500 for materials only. Bracken control over 5-6 acres has been

worth at least £1,500 to the estate, again at no cost. The cost/benefit ratio of the area fenced at C.C.T. expense has been left out of account. For a variety of reasons, these figures can only be very rough estimates.

An Overview and Some Conclusions

We have seen how humankind and closed woodland arrived in this area at much the same time, around 8,000 to 9,000 years ago, how domestic animals were brought in somewhat later, and how the first cultivation of the soil began about 4,000 years ago, although it may have remained at an insignificant level until the Iron Age around 2,500 years before present. Although we cannot tell precisely when cultivation began at Ardentallen, we do know that it ended abruptly around the middle of the present century and that since then land use has been predominantly pastoral once again.

Some form of woodland management must have existed from earliest times until around the end of the 18th century, when the present structure of the existing woodland was determined. Since then there have been sporadic episodes of mainly birch, hazel and ash regeneration as grazing intensity has fluctuated. This continued at a very low level until the late 1970s, when all tree regeneration ceased in the face of exclusive sheep stocking pushed to its limit, with the assistance of increasingly moist summers and mild winters, and finally halted by steady pasture deterioration.

An episode of ill-advised 'suburban' development occurred on the inner coastal strip in the early 1960s, and shortly after this equally ill-advised conifer plantations were established in the same area and also at the southern end of the outer coastal belt. On balance, these developments may not have affected the total plant and animal diversity and, so far as is known, they did not obliterate any features of archaeological interest. However, the area had now been opened up by a metalled road and has become increasingly affected by human disturbance, both resident and seasonal, over the last three decades. The decrease in the population of several species of mammals and birds is very obvious. The catastrophic disappearance of most species of butterflies in the late 1980s, on the other hand, was entirely climatic and is only gradually being reversed. The less sudden but equally unfortunate decrease in many of the scarcer and more interesting plants can be laid squarely at the door of the ubiquitous sheep. Saddest of all is the continued demise of an ancient woodland and the conversion of its distinctive ground vegetation to bracken-infested grassland or to bare stony slopes littered with fallen dead wood. At the present time it is difficult to see how this is going to be put right, but I have tried to show the way and can only hope that some of my endeavours will not have

been in vain. Unfortunately, expertise gained in this way is not readily transferable to new areas nor to individuals who prefer to learn from their own mistakes!

When talent spotting for oakwoods in Argyll for the old Nature Conservancy in the 1950s I missed the Ardentallen woods, as did the Conservation Review of the late 1960s and early 1970s. An attempt at S.S.S.I. listing was made at a later stage, but political considerations had intervened by then and consequently the area has no statutory protection at the present day. The 'Ancient Woodland' and 'Scottish Wildlife Trust Site' classifications are virtually worthless. The 1.5 ha fenced area can be looked after by C.C.T. until the year 2010, but unless further action is taken, on a site now known to be of national importance, much of what has so far been achieved will then have to be returned as grist to the sheep mill.

Note Added at Proof Stage

From October 1995 it became impossible to carry out even minimal maintenance of the developing young trees, and the casualty rate increased in all age groups. There cannot now be more than 800 - 900 remaining (cf. page 61). Between felling and natural wastage over the last decade, losses have thus far outweighed replacements throughout the woodland as a whole.

In 1995, and again in the spring of 1996, a J.C.B. excavator was brought in to improve access to the hill ground for tractors and various 4 x 4 vehicles. This involved felling several mature oaks and a greater number of large hazels and young ash with much side-lopping of further oak and hazel, the obliteration of the old hill-track in its surviving form, and the destruction of short lengths of the central march dyke. A number of young trees up to 6.0 feet tall and some others, still netted or in tubes, were also destroyed in this work. The old dyke backing the house plot reservation was also broken through, to allow excavation of the scree slope below the C.C.T. fenced area for hard core.

In March 1996, areas of dense bracken and whin scrub bounded by the sanatorium hollow, Am Buth and the central march dyke, were set on fire and further young trees up to 5.0 feet tall were destroyed. The plastic tubes in this area were incinerated, and Plot 4 was also burned out, although some of the taller birches in it may recover. As a result of the J.C.B. work and the fires, all remaining oak plants functioning as experimental controls, except those within the 1.5 ha fenced area, have now been destroyed. In early April, burning of the bracken litter, whin scrub and dead grass was extended further to the north-west across the hill ground.

Feeding of Rumavite has been continued over what has been a cold winter and a late spring so that sheep browsing on the many lopped and windthrown tree branches has been more marked than ever before. Young ash and willow trees up to 30 cm basal diameter have been ring-barked and, while some of the larger may survive, many young ash, willow and elm established over the last ten years are bound to succumb. Even the few young alders have been gnawed. An exceptionally abundant crop of hazel catkins over this period proved tempting to the hungry animals which went to extraordinary lengths to reach them on the lower branches and, since the young hazels too have now reached catkin-bearing age, these were pushed over and the stakes snapped to an extent not previously seen.

The garden ground of Lower Ardentallen has been extended by some 2.0 acres to the north and the whin scrub cleared, thus reducing still further the area of grazing and browse available. Some clear felling of the inner coastal conifer plantations is being carried out.

An area of bracken on the more accessible south-facing slopes was cut once with a powerful new tractor and 'Bush-Hog' in July 1995, but this was not followed up and is unlikely to have any greater effect than previous efforts by the grazing tenant with his old machine and cutter bar.

Finally, it is understood that a survey of the Ardentallen peninsula has recently (early 1996) been carried out by the Scottish Agricultural College (Oban office) with a current Farm Woodland Premium Scheme in mind. Some form of Woodland Grant Scheme (at present subject to frequent alterations) can theoretically be combined with this, but, as they stand, the F.W.P. Schemes are designed primarily to maximise inward cash flow in the form of available grants, and have little to do with improved land use or native woodland conservation.

APPENDIX 1

Flowering Plants and Ferns

This is not a complete check-list of the species which have been recorded at Ardentallen; it is simply an annotated list of the more noteworthy. There is only one national rarity, but a few are far from common in the region and one or two occur in unusual situations. The vegetation-forming species, which can be expected to occur practically everywhere in this area, have been omitted. Critical genera (those in which species differentiation requires the assistance of a specialist) such as *Hieracium, Taraxacum, Rosa* and *Rubus* have not yet been studied. Nomenclature follows Clapham, Tutin and Moore (1987), but the order is alphabetic not taxonomic.

Allium ursinum

Confined to lime-rich soil within the fenced area, where it is now spreading.

Allium vineale

One small patch on shore rocks and adjacent turf where the sheep rarely allow bulbill formation. Close to old runrig cultivation, where it may have been a weed.

Anagallis tenella

Recorded from the 10km grid square, but never found in this study. Accidentally introduced to bog near the watercress spring.

Anemone nemorosa

Small patches widely scattered in woodland, on steep banks and under bracken, but rarely flowering due to sheep grazing. Now recovering and flowering within the fenced woodland.

Antennaria dioica

One small patch on wet, peaty grassland 25 m above sea level. Stolons ripped up by sheep at flowering time each year. Disturbed by J.C.B. excavator in March 1996.

Anthyllis vulneraria

Fewer than ten plants in turf on shore rocks. Has survived close to rocks where sheep cannot graze closely. Unsuccessful attempt at rescue.

Arabidopsis thaliana

On blocks of calcareous agglomerate below outer woodland, and on one crag of the same rock uphill from watercress spring. Survives only out of sheep reach.

Arabis hirsuta

A few plants in scattered localities on calcareous andesite and black limestone from Minard march to Sailean Ruadh. Survives out of sheep reach.

Asplenium scolopendrium

A few plants at the back of rock shelters on the main post-glacial raised beach where sheep cannot penetrate. Also at small quarry hole.

Botrychium lunaria

Between 50 and 60 plants, mostly in two patches, under full tree canopy in fenced woodland. Seems to be increasing under protection from sheep and slugs.

Bromus ramosus

Abundant in species-rich woodland within fence. Scattered plants throughout wood.

Carex acutiformis

A large area dominated by the species occurs in the shore marsh between Sailean Ruadh and Ardentallen Cottage.

Carex rostrata x *vesicaria*

One extensive patch in marsh near Minard march. A few plants close to *Carex vesicaria* also found on margin of one wet spruce plantation.

Carex sylvatica

Scattered on lime-rich ground in woodland and open. Component of species-rich woodland in fenced area.

Note: About ten other species of *Carex* occur.

Cephalanthera longifolia

About twenty-five plants now located within fenced area. Sporadic appearances elsewhere are sought and translocated within fence. A national rarity.

Chamaenerion angustifolium

Repeated attempts at colonisation so far frustrated by sheep. Nearest seed source across Loch Feochan. One shoot within fenced area. Also found as epiphyte on oak.

Corydalis claviculata

Uncommon even ten years ago, but now spreading rapidly in many areas of dense bracken. Eaten by sheep when withering back in autumn.

Dactylorhiza fuchsii

Uncommon in the more lime-rich shore marshes and being quickly eliminated by sheep.

Dactylorhiza incarnata

Two or three flowering spikes have appeared over several years in one small area of bog below the watercress spring.

Dactylorhiza majalis ssp. *purpurella*

More widely scattered and in more acid places than *D. fuchsii*, but also being rapidly eliminated by sheep grazing.

Daucus carota

One plant noted at slate quarry in 1987. Status otherwise unknown.

Elymus caninus

Found once on inaccessible ledge of outer woods. Also on coastal ledges between Minard and Gallanach.

Galium odoratum

Widespread on lime-rich crags and banks out of sheep reach. Now spreading in fenced area.

Geranium dissectum

Localised along edge of maritime turf where it meets beach shingle and shore rocks on the outer loch. Occasionally on agglomerate blocks. May have been grazed out of one site in turf near shore.

Geranium lucidum

Sparsely scattered on lime-rich agglomerate blocks in outer woodland. Now apparently eliminated from second locality near the sandstone quarries but survives in garden adjacent.

Gymnadenia conopsea

Three plants known close to site of *Dactylorhiza incarnata.* Now protected by fence.

Gymnocarpium dryopteris

Abundant in one patch of woodland facing north-east. Some translocated the short distance to the fenced area, although this fern is not normally grazed by sheep.

Hypericum androsaemum

Now spreading throughout fenced area, where only three plants were formerly known. Otherwise reduced to a few depauperate plants on wet, lime-rich rocks in outer wood.

Jasione montana

Small patch inside gate at Lower Ardentallen. Otherwise roadside occurrences stop at Lerags.

Juniperus communis

Not recorded on Ardentallen, but one female plant known near Minard Cottage and one by roadside at Kilninver.

Lythrum (Peplis) portula

One small patch in clearing in dense *Juncus effusus* which floods in winter behind Ardentallen Cottage.

Lythrum salicaria

A few plants in rushes with *L. portula.* Second locality in shore marsh eliminated by spruce plantation in early 1970s.

Lycopus europeus

Occurs sparsely in shore marsh of inner loch.

Medicago lupulina

Rare in shore grassland of outer loch.

Melica uniflora

Abundant in fenced woodland. A few tufts on lime-rich crags throughout woodland.

Menyanthes trifoliata

A small patch occurs in the march close to the Minard march fence and may mark former open water. It is now protected to some extent and succeeds in flowering.

Mimulus guttatus

Only along the march burn in Minard Glen with watercress.

Moehringia trinervia

Local patches in wet woodland and on rock faces.

Ophioglossum vulgatum

One colony of several hundred plants in woodland clearing with complete summer bracken cover. There is winter flooding here and a woodland/marshland vegetation below the bracken.

Orchis mascula

Mainly on one wet slope in outer woodland. Otherwise sporadic in lime-rich places and fast decreasing due to sheep grazing. Translocated to fenced woodland although the slope is rather dry.

Phegopteris connectilis

Abundant in one patch of woodland facing north-east. Otherwise uncommon on steep rocks and banks.

Platanthera chlorantha

Formerly by the roadside near Campbell of Lerags Cross. No Ardentallen records, but possibly could have been eliminated by sheep grazing.

Polystichum aculeatum

On wet rocks in outer woodland. Not abundant.

Populus tremula

Introduced.

Prunus padus

Introduced.

Rosa pimpinellifolia x *canina* agg.

A few plants on rocks and crags out of sheep range in inner and outer woods.

Sanicula europea

A few patches in various parts of the woodland and scrub. Only flowering out of sheep reach and in the fenced area. Becoming less abundant.

Saxifraga hypnoides

Scattered patches on lime-rich agglomerate blocks and scree in open canopy of outer woodland. Translocated to similar ground in fenced area.

Scrophularia nodosa

Increasing in the species-rich area of the fenced woodland. A rarity elsewhere due to sheep grazing.

Selaginella selaginoides

Locally common in bogs and in short turf where irrigated, but rarely seen fruiting where sheep graze.

Silene dioica

Common on lime-rich rocks inaccessible to sheep. Now increasing in the fenced woodland.

Silene vulgaris ssp. *maritima*

On shore rocks and crags of the outer loch where out of sheep reach.

Sorbus rupicola

Introduced on the black limestone.

Sparganium erectum

In the small waterfilled quarry hole at the roadside, but rarely flowering well due to sheep.

Taxus baccata

Introduced. Seed collected from apparently natural yew population on Minard Point cliffs.

Torilis japonica

On dry rocks in woodland inaccessible to sheep. A roadside plant from Lerags to Kilbride.

Triglochin maritima

Local in salt marsh turf.

Triglochin palustris

Local on shore and hill bogs.

Vaccinium myrtillus

Present in dwarfed form in many vegetation types. Now flowering in fenced woodland.

Viburnum opulus

Introduced.

Vicia sylvatica

Two patches known on rock faces out of sheep reach. Introduced to fenced woodland, where one plant is spreading widely.

Zostera marina / Zostera noltii

Below low water springs at Sailean Ruadh.

APPENDIX 2

Bryophytes and Lichens

Few species of outstanding interest in either of these groups have as yet turned up, but the list is a long one and consists of those species to be expected in an

ancient oceanic woodland where calcium-rich and acidic rocks occur in close juxtaposition. This is not the most oceanic area of the west Highlands by any means, but over 100 species of bryophytes have been recorded from the woodland alone. *Metzgeria temperata* and *Plagiochila killarniensis* are worthy of special mention. The lichens have not been studied so systematically, but trees and shrubs carry most of the expected species of *Lobaria, Sticta, Parmelia, Parmeliella* and so on. *Sticta canariensis* has been recorded from the north side of a few of the large agglomerate blocks in the outer woodland. No recording of micro-lichens has been undertaken. Overhanging andesite crags sometimes carry large colonies of *Dermatocarpon miniatum* on the dry faces. There are not many species of *Cladonia* but some can be found on oak stems, old stumps and patches of bare peat in the bogs. There are few ground lichens, in comparison with epiphytic and epilithic species.

The moss element of the vegetation is important in woodland and non-woodland alike. The heathy facies of the woodland floor is dominated by *Rhytidiadelphus loreus* and *R. triquetrus* with *Dicranum majus* and numerous feather mosses, while most of the open grassland has a mat of *Rhytidiadelphus squarrosus* with much the same selection of feather mosses, such as *Thuidium tamariscinum, Hypnum cupressiforme* and *Pleurozium schreberi.*

The grassland moss mat is at its most conspicuous over the winter months and, in fact, it may help to protect the grasses from overgrazing then as the sheep try to avoid a mouthful of moss. In spring, when the new grass is sprouting, much more moss is pulled up and left lying on the surface.

The wet peat communities have a greater representation of *Sphagnum* and *Polytrichum* species, with some *Leucobryum glaucum and Dicranum scoparium* as well as many of the grassland mosses just mentioned. The less acidic boglands, dominated by grasses and rushes, have small patches of *Philonotis fontana, Acrocladium cuspidatum, Brachythecium rutabulum* and *Breutelia chrysocoma.*

Some epiphytic lichens of tree trunks and branches

Lobaria pulmonaria
Lobaria laetevirens
Lobaria scrobiculata
Lobaria amplissimma
Evernia prunastri
Hypogymnia physodes
Peltigera canina
Peltigera polydactyla
Peltigera horizontalis
Parmelia caperata
Parmelia laevigata
Parmelia crinita

Hypogymnia tubulosa
Sphaerophorus melanocarpus
Sphaerophorus globosus
Sticta sylvatica
Sticta limbata
Ramalina calicaris
Ramalina fastigiata
Parmeliella atlantica
Sticta fuliginosa
Pseudevernia furfuracea

APPENDIX 3

Inventory of Archaeological Features

1. Various stone gatherings on slate outcrops east of public road to Ardentallen House.

2. Cairn composed of several large boulders, including glacial erratics, on north-west side of Druim Ban. NM 836 242.

3. Cairn complex of loose stones in 15 m diameter circle on edge of woodland above 'Fearnoch'. NM 833 277.

4. Possible chambered cairn with earth-fast boulders and associated stone alignment. Contiguous with No. 3.

5. Two cairns of earth-fast boulders covered with turf between old hill road and garden fence line.

6. Rectangular cairn of earth-fast and loose stones in garden ground of 'Siol'. Possible burial cairn.

7. 'Sanatorium' complex of stone banks, rectangular 'chapel', burial cairns, sub-circular hut foundation, platforms, etc. Also cairn, stone alignments and burial cairns in wet area downhill. NM 832 236.

8. Formerly unrecorded kerb cairn above fenced area of woodland. Now excavated, replaced, notified and written up. NM 830 236.

9. Various stone gatherings associated with old cultivation, including ridge and furrow.

10. Two rectangular building foundations, with side entrances, on the upper slopes of Minard Glen. NM 828 237.

11. One round-ended building with side entrance, all foundations turf-covered, on the watershed. NM 827 235.

12. Multiple cairn, resembling No. 3, but smaller and possibly with recent stone gatherings, on hill shelf above the Lower Ardentallen bog.

13. Rectangular building foundation, with garden enclosure, in spruce plantation. Mapped in 1871. Disturbed by ploughing in 1963. NM 828 228.

14. Line of small cairns with cores of large stones between woodland and shore north-east of Ardentallen Point. NM 826 227.

15. Possible chambered cairn with large stones between woodland and shore north-east of Ardentallen Point. NM 825 228.

16. Alignment of large stones near shore west of Ardentallen Point.

17. Indefinite building foundation on spur above Lower Ardentallen water tank.

18. Long cairn of loose stones just below No. 17. Resembles stone gathering, but old cultivation absent.

19. Sub-circular feature, visible in turf of lowermost raised storm beach, west of Lower Ardentallen sheep fank. Resembles possible kelp-burning stances reported from Islay and elsewhere.

20. Seven recessed hut platforms, five in inner, two in outer, woodland. Four have been used as charcoal stances at a later date. NM 832 235.

21. Shell midden in rock shelter at about 14 m above sea level. Has been disturbed but never properly excavated. NM 823 233.

22. Old slate quarries at Ardentallen Farmhouse and at tidal narrows in 'Caladh' garden ground. NM 836 238 and NM 829 229.

23. Three water-filled holes and several dry working faces of old sandstone quarries between 'Sealasdair' and Ardentallen Point.

24. Oval mound covered by soil and dense bracken close to the central transverse turf dyke.

25. Two small boulders capping large earth-fast erratic near No. 15. Not perched blocks, and probably not done with farm machinery at a recent date.

APPENDIX 4

Shell Deposits

Site A. Behind Sandstone Quarries.

Exposure

2-3 m marine clay and beach deposit with 1.0 m solifluction head or slippage debris. Base of clay below water level in quarry and close to H.W.M.O.S.T.

Shells from reworked deposit

Species List

*Balanus balanus**
*Balanus crenatus**
*Mytilus edulis**
Littorina littorea
Littorina littoralis
*Littorina rudis**
*Nucella lapillus**
*Gibbula cineraria**
*Gibbula umbilicalis**
Gibbula cf. *tumida** (non-littoral)
Nucula sp. (bored by gastropod cf. Natica sp.)
Muricid spp. (cf. two non-littoral)

* Not at site B

Site B Salt-Marsh between Lerags House and Ardentallen House.

Exposure

Deposit extends to 1.0-2.0 m above H.W.M.O.S.T. below Lerags House and perhaps across much of the inlet. Top of shell bed exposed by stream from

under 40-50 cm salt marsh turf. Shells both fresh and badly eroded appear *in situ.*

Species List

Littorina littorea
Littorina littoralis
Nucula cf. *turgida*
Gibbula sp.
Modiolis modiolis
Acanthocardia tuberculatum
Aparthais pes-pelicanis
Chlamys opercularis
Chlamys. cf. *varia*
Venerupis decussata
Venerupis pullastra
Mya truncata
Turritella communis
Bittium reticulatum/cerithiopsis
Buccinum undatum/tuberculatum
Lucinoma borealis
Mysia undata
Abra alba/prismatica
Ostrea edulis
Pecten maximus
Arctica (Cyprina) islandica
Patella vulgata (fragments)
Barnacle fragments
Annelid tubes
Serpula vermicularis tubes on stone
Lutraria lutraria

Site C. Mesolithic Shell Midden, outer Loch Feochan.

Superficial examination only.

Species List

Littorina littorea
Patella vulgata
Nucella lapillus

Solifluction head.

Reworked beach deposit. Cobbles with attached barnacles.

10 cm barnacle marl.

Marine clay with granitic partings.

Main clay body with only slate and andesite particles.

Figure 19

Shell deposits. Profile of Site A.

Figure 20

Shell deposits. Profile of Site B.

Figure 21

Shell deposits. Profile of Site D.

Site D. Eroded Face of Shore Marsh at H.W.M.O.S.T., outer Loch Feochan.

Exposure

75 cm reworked clay with gravel resting on bedrock or beach boulders.

Species List

Astarte elliptica (entire)
Littorina rudis (fragments)

APPENDIX 5

The Flooded Quarry Holes

The three water-filled quarry holes are the only permanent bodies of standing water on the Ardentallen peninsula. Boggy areas on the high ground are only seasonally flooded in places. The watercress spring above 'Caladh' water supply is too small to be of much significance. All three quarries are marked on the map of 1871, but the two principal holes are shown as smaller than they are now, so the working faces were probably still being extended. If they flooded in 1881 and were then abandoned, they have been filled with sea water for over 100 years with a layer of fresh water from land drainage lying to a variable depth on top. The small quarry by the roadside south-west of the main slate working seems not to have been extended since 1871 and, since water flows from it to join the little burn which flows through the garden of Lower Ardentallen, it was probably abandoned when the spring was originally encountered. The depth of this hole is unknown, and its main feature of interest lies in the colony of *Sparganium erectum* mixed with *Iris* around the bank. There are also two large plants of hart's tongue fern, inaccessible to sheep, between the water and the road. The most probable explanation for the occurrence of *Sparganium* here is that birds have carried the seeds from other colonies not far away - perhaps on Kerrera or on the lochs of Raera forest.

The other two holes have several features of interest. The one next to the road is tidal, at least at high water springs, but holds the water when the tide drops. It may have a less reliable surface layer of fresh water than the inner hole, which is not affected by high tides and which receives a trickle of drainage water over the clay face described in Appendix 4, except in dry weather. This water drains the calcareous rocks of the fenced woodland, and so is quite rich in calcium. The underlying water is brackish but its salt content is unknown. There are a small number of shrimps of two species - a *Gammarus* and a *Schistomysis* - in both holes.

The marginal stones within the fresh water layer are covered with thick gelatinous masses of the Cyanobacterium *Microcoleus lyngbyaceus.* An algal bloom occurs at the separation of the two layers in spring and sometimes reveals an intricate circulation pattern in the surface water according to wind strength and direction.

APPENDIX 6

Some Dated Events in the History of Ardentallen

1680 Donald Campbell of Lochnell became first heritor of Ardentallen. In this same year Argyll gained the support of Charles II against the MacLeans of Mull, who made their last stand on the Treshnish Islands.

1737 First Ardentallen House built, perhaps by Campbell of Ballimore who is recorded as the heritor of the four merklands of Ardentallen (value shown as £83-6-0d) in 1751.

1750 First record of woodland at Ardentallen. Military map of General Roy.

1793 Contract for a supplementary felling of woodland at Ardentallen drawn up and signed between Ardentallen Estate and Lorn Furnace Company.

1800 (circa). Ardentallen passes into the ownership of the McDougalls of Gallanach, and Ardentallen House becomes their dower house. Gallanach House itself was not built until 1804.

1882 Possibly the end of slate and sandstone quarrying.

Post-1945
End of farming in 1950s, with splitting of the property along different boundaries, and numerous changes of ownership up to the present day.

NOTE

Many vertebrates and invertebrates are involved with the fate of trees and seedlings, and selected species lists of the mammals, birds, other vertebrates and invertebrates for the area have been compiled over the years. Information on these can be obtained from the author.

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Needless to say, any factual errors or mistaken interpretation are entirely my own responsibility.

References

Birks, H.J.B. (1989). Holocene isochrone maps and patterns of tree-spreading in the British Isles. *Journal of Biogeography,* **16**: 503-540.

Clapham, A.R., Tutin, T.G. and Moore, D.M. (1987). *Flora of the British Isles.* 3rd edition. Cambridge: Cambridge University Press.

Darling, F.F. (1955). *West Highland Survey: An Essay in Human Ecology.* Oxford: Oxford University Press.

Geological Survey. (1959). Sheet 44, Solid Edition, One Inch Series. Also Memoir to Sheet 44.

Gillies, P.H. (1909). *Netherlorn, Argyllshire, and its Neighbourhood.* London: Virtue & Co.

Gray, J.M. (1978). Return to the Ice Age possible within a century. *Oban Times,* 12th January 1978.

Hunter, C. (1992). *Oban - Prehistory.* Lerags: Privately published.

Lindsay, J.M. (1975). Charcoal iron smelting and its fuel supply; the example of Lorn Furnace, Argyllshire, 1753-1876. *Journal of Historical Geography,* 1: 283-298.

Macdougall, H. (1979). *Island of Kerrera: Mirror of History.* 2nd edition. Ganavan House: Privately published.

Macklin, M.G., Rhodes, A.N. and Rumsby, B.T. (1991). *Holocene Palaeoenvironments and Prehistoric Human Activity in Glean Sheilach, Oban, Scotland: a Preliminary Report to the Scottish Development Department.* Geography Department, University of Newcastle-upon-Tyne.

McVean, D.N. and Lockie, J.D. (1969). *Ecology and Land Use In Upland Scotland.* Edinburgh: Edinburgh University Press.

Rennie, E.B. (1992). An Investigation into the history and function of the so-called charcoal burners' platforms in the west of Scotland. *Scottish Naturalist,* **104**: 51-111.

Rennie, E.B. (1994). The recessed platforms of western Scotland. *Current Archaeology,* **138**: 204.

Rothero, G. and Thompson, B. (1994). *A Checklist of the Flowering Plants and Ferns of Main Argyll.* Oban: Argyll Flora Project.

Sissons, J.B. (1967). *The Evolution of Scotland's Scenery*. Edinburgh: Oliver & Boyd.

Steer, K.A. *et al.* (1975). *Argyll. An Inventory of the Ancient Monuments.* Volume 2: *Lorn.* Edinburgh: Royal Commission on the Ancient and Historical Monuments of Scotland.

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